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Some Aspects of Cotton Industry in India

THE cultivation of cotton in India dates back to pre-historic times. Until a few years ago our only sources of information regarding the antiquity of cotton were scanty references in religious books, which left it uncertain whether India or Egypt was the first country to grow and manufacture cotton on a large scale. Recently, however, when the excavations at Mohenjo-daro made 'the dead yield up their secrets', a few specimens of beads, razor blades and other household articles were unearthed, which were found to be wrapped up in some kind of textile material. Time had treated this material none too gently, it was so tender that it fell to pieces in handling; with great care, however, some pieces of fibres and bits of yarn were removed from it, and these showed unmistakably the characteristics of cotton. It was thus proved, beyond a shadow of doubt, that the world is indebted to India for the first steps in the cultivation and manufacture of cotton, which to-day constitutes over 75% of all the textile materials.

These tests, which were carried out at the Technological Laboratory of the Indian Central Cotton Committee, further revealed the fact that as far back as 3500 B.C., not only was cotton being cultivated in India, but that its manufacture had reached a surprisingly high standard for those ancient times. Since then the cultivation and manufacture of cotton in India made a steady progress, until, in the middle ages, the fame of her fabrics spread far and wide, and she did a flourishing trade in textiles with other countries. The enchanting beauty of her muslins and nainsooks and the amazing variety in design and colour of her fabrics have become legendary and need no repetition;

what is perhaps not generally known is the fact that, as late as 1815, India exported to England alone cotton goods worth £1,300,000. These halcyon days of industry and prosperity were followed by a dark period of decline and depression, when India lost not only the major part of her export trade in cotton fabrics, but also the seed of some of her best cottons. The development of her own textile mills and the demands for raw cotton from outside markets helped to revive the industry and to expand the area under cotton. During the last few decades efforts have been concentrated upon improving the quality of the indigenous types or upon the introduction of exotic varieties, which may give a higher monetary return to the grower. Although these efforts have, to some extent, been thwarted by bad picking, defective ginning, adulteration, watering, etc., it can be claimed that a very definite measure of success has already been achieved.

India to-day occupies first place in the British Commonwealth of Nations and the second place in the whole world in respect of the total *quantity* of cotton produced each year. The area under cotton has ranged from 22·4 to 27 million acres in the last decade, yielding a crop of 4½ to over 6 million bales per annum. But India of to-day is not a mere cotton-producing country. Beginning in a modest way in 1851, her textile industry has developed steadily until in 1937 her 370 mills, equipped with over 9 million spindles and nearly 2,00,000 looms employed over 4,00,000 hands, and produced more than 3,000 million yards of cloth. Even these huge figures do not complete the picture; India, after satisfying the major portion of her own needs, has been able to export every year nearly 3 million bales, worth about Rs. 30 crores, in these days of low prices, to other countries. Thus, if we consider the triple aspects of cultivation, manufacture and export trade, cotton represents easily the largest and the most highly organised industry of India.

The cultivation of cotton in India possesses certain features, which are not seen, at least to the same extent, in the other principal cotton-growing countries. It will be instructive to consider them briefly. In the first place, cultivation of cotton in India is not confined, as is the case in the United States of America or Egypt, to a narrow belt in which the soil and climatic conditions do not undergo large variations. With the exception of Bengal, Bihar, Assam and the N.W.F. Province, cotton is grown over the entire length and breadth of this sub-continent. This wide-spread cultivation has two important consequences. Firstly, owing to the widely different conditions of soil and climate prevailing in different parts, the Indian cottons range in quality from the coarse and short-stapled Bengals (which incidentally are not grown much in Bengal) to the fine and long-stapled Sind-Egyptian or Punjab-American 289 F. Probably no other country in the world offers such a striking contrast either in the times of sowing and harvesting of its cottons or in their physical characters. Secondly, each large tract has its own special problems of varietal improvement, agronomy, cotton diseases and pests, etc.; and though co-ordination is desirable to avoid duplication, it is necessary that botanical, physiological and agronomical researches must be carried out at several centres. For this purpose funds, and more funds, are required, which should be made available in view of the position which cotton occupies in our national economy and industrial development.

The second peculiar feature of the Indian cotton crop is its low yield per acre. The

average for the whole country for the last 10 years has been only 85 lbs. of lint per acre, which is very poor as compared with the American average of 190 lbs. per acre and miserable as compared with the Egyptian average of 446 lbs. A direct result of this low yield is that unless the price of cotton is high, the small cultivators, owning a few acres of land, live in a state of semi-starvation, and after satisfying their bare needs have no money left to put back into the land. Unless some extraordinary events occur, the world factors do not indicate that any substantial increase in the price of cotton is likely to occur in the near future. It is, therefore, essential that the means which are already being adopted to increase the yield per acre should be intensified so that the farmers may raise their standard of living. These means consist of the development of high yielding varieties, the use of manures and fertilisers, the supply of water by canals, wells and tanks to areas which depend at present upon the vagaries of monsoon, the conservation of moisture by bunding, the prevention of soil erosion by reafforestation, the application of better methods of sowing and tillage, the elimination of weeds and the control of pests, etc. Some of these measures like elimination of weeds, preparation of bunds, etc., the farmer himself can undertake provided they are demonstrated to him; in others like the supply of cheap fertilisers and manures, maintenance and supply of pure seeds, control of pests, etc., he needs the assistance of co-operative bodies or the Local Governments; in yet others like irrigation schemes, re-afforestation, etc., he is directly dependent upon State aid. Some of these measures are being tried in limited areas; it is necessary that they should be extended considerably; others have been sadly neglected, it is imperative that they should be taken in hand according to a well-designed plan. Only in this way will it be possible to re-habilitate the fertility of our soils and improve the condition of the millions who derive their living from it.

The third peculiar feature of the Indian cotton crop is the distribution of the different varieties in it. We have mentioned above that these varieties cover a wide range of staple length, but the distribution is far from being even; the comparatively long types are grown in small quantities, while the short-stapled types are grown in superabundance. It is estimated that in the total crop of over 6½ million bales of 1936–37, only 200,000 bales or 3% possessed a staple of 1" or more, while fully 4 million bales or 66% possessed a staple of 11/16" or under. These percentages offer a striking contrast to conditions in U.S.A., where out of a total crop of 12 million bales in 1936 only 9·5% were shorter than 14/16". The direct result of this grossly uneven distribution of varieties in regard to length is that while, on the one hand, we are burdened with a surplus of short-stapled cottons for which we must find export markets, on the other hand we are faced with a deficiency in long-stapled cottons for the growing needs of our cotton mills. It is, therefore, necessary that we must plan the development of our improved varieties and their cultivation on such a scale that the supply of different types fits in more appropriately than at present with our requirements in the home market and abroad. If such measures are co-ordinated with those directed towards raising the yield per acre, it is possible that we may have to reduce the total area under cotton. There are some 'marginal lands' where the cultivation of cotton under the present-day conditions is hardly a paying proposition; if the yield in

other lands is raised and improved types are grown on them, these marginal lands can well be utilised for growing food crops of which there is a considerable deficiency for our vast and rapidly increasing population.

We have made a passing reference to the large quantities of cotton purchased each year by other countries which in 1937–38 amounted to nearly 17% of our total exports. The Indian cottons have to sell in an open world market in competition with the produce of other countries; it is therefore very necessary that the quality and grade of our cottons should be maintained at as high a level as possible so that the agriculturists may reap the maximum profit from their labours. The terms 'quality' and 'grade' are sometimes vaguely used as being synonymous; when applied to cotton, each has a definite significance. Quality refers to the physical characters of the fibre such as average length, fineness, maturity, etc., which have a bearing upon its spinning performance; while grade refers to the amount of trash and foreign matter such as leaf, seed-coat bits, sand, etc., present in the cotton. Improvement in quality is a slow and difficult process, but improvement in grade can be effected more quickly and easily by paying proper attention to picking, pre-cleaning, ginning and pressing. It is unfortunately the case that often the good quality Indian cottons do not obtain their full value on account of their poor grade. The presence of leaf bits, cut and unripe seeds, stains, etc. 'hits the customer in the eye', so to say, and detracts from the real merits of the cotton. These defects can be removed by cleaner picking and better ginning and pressing. For the former vigorous propaganda is necessary; for the latter both propaganda as well as systematic investigations on the optimum conditions of ginning Indian cottons are required. During the last few years a great deal of work along these lines has been done in the United States of America, where the authorities are fully alive to the necessity of improving, or at least maintaining, the grade of their crop in these days of severe competition; in India with the exception of a few large firms we have eschewed this important field. It is, however, a matter of gratification to note that the Indian Central Cotton Committee has recently sanctioned a scheme for starting a Ginning Section at its Technological Laboratory, where these problems will be studied in a scientific manner and the results placed at the disposal of the ginning factory owners.

While we are on the subject of quality and appearance of the Indian cottons, we may also mention two other sources of weakness, which require increased attention and vigorous steps to eradicate them. These are the two malpractices commonly known as watering and mixing. The former consists in deliberately adding water to cotton, over and above what it normally absorbs from the atmosphere, in order to increase the weight of the bale. The water thus added makes the fibres matted and helps to multiply the bacteria and fungi, which, to a greater or less extent, are generally present in cotton, but which do not thrive in a dry atmosphere. These micro-organisms, if allowed to grow when the cotton is stored for some time, destroy the cotton fibre, give it a peculiar dirty-grey colour and altogether reduce the quality of the material. In view of the damage done by watering, every effort should be made to stop this malpractice. In some cases the Provincial Governments have passed the necessary legislation to punish those who indulge in it; this should be extended immediately wherever this undesirable practice raises its head.

The second malpractice consists in deliberately adulterating a good quality cotton with an inferior and cheaper cotton and passing it off as the former. This practice is more widespread than watering, and because the detection of two cottons in a mixture presents certain technical difficulties, it is more difficult to tackle successfully. It enables the party indulging in it to make a short-lived profit, but as the mills fail to obtain the expected results, they grow suspicious and the whole district, or even the tract, suffers in reputation. Vigorous propaganda, backed by legislative measures such as preventing the transport of inferior varieties in the areas growing superior cottons are necessary to curb this malpractice.

The two malpractices referred to above are objectionable from another point of view. During the last two decades considerable amount of work has been done in evolving new and improved varieties, in which the Indian Central Cotton Committee has played a very important part. This work has entailed the labours of a large number of research workers and the expenditure of moderately large sums of money. It is capable of yielding the best results only if the varieties so evolved are grown in a pure state and presented to the customers in an unadulterated and clean condition. If these pre-requisites are not fulfilled, neither the growers nor the consumers would get the fullest benefit from the efforts of the research worker, who is sometimes blamed by persons, not in the know of facts, for not producing spectacular results.

These are some aspects of the Cotton Industry in India relating to its progress from the field upto the factory. There are others which relate to its treatment within the factory and its utilisation for other than textile purposes. We shall deal with these in a subsequent issue.

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OPTICAL instruments are playing an increasingly important rôle in modern science and industry. The biologist needs his microscope, the engineer his transit, the metallurgist his spectroscope, the movie technician his camera and floodlights, the astronomer his telescope, and the flight navigator his drift indicator and sextant. Specialised knowledge and skill are required in the design and manufacture of all these instruments. "Optics" has thus become a profession which demands the service of experts in optics and optical engineering. The future of the profession is no less promising: already, more and more opportunities are provided in the applications of photo-electric cells, the electron microscope, television, etc.

It was essentially to meet these demands that the University of Rochester, founded in 1930 an Institute of Optics, with the enthusiastic co-operation of the famous firm of **Bausch & Lomb Optical Co.** The Eastman Kodak Co. has also made substantial contributions towards the establishment of this Institute. Rochester is in the centre of the great Optical Industry of America and by associating the Institute, with the well-known Department of Physics of the University, unique facilities are afforded for full instruction in all the fundamentals of optics and at the same time connecting the classroom work with research and practical achievement in the profession itself. The course is a four-year one, leading to the degree of *Bachelor of Science* in Optics. Those interested in further details, regarding expenses, student life at Rochester, list of courses, etc., are invited to write to the Director, The Institute of Optics of the University of Rochester, Rochester, New York.

Evolutionary Significance of Chromosome Size and Chromosome Number in Plants

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POLYPLOIDY in plants is a very common phenomenon. Its evolutionary significance was first recognized by Winge[1] (1917) about twenty years ago and is generally accepted at the present time.

The behaviour of the chromosomes of various sizes in diploid and polyploid plants, which I have studied recently,[2] and those studied by other investigators, suggested that the size of chromosomes may play an important rôle in the survival of the polyploids, *e.g.*, in the evolution of plants. The studies on the chiasma frequency in long and short chromosomes[3–8] and even in long and short arms of one and the same chromosome[9] showed that the mean number of chiasmata per bivalent and per arm is approximately proportional to the length of the pairing blocks. This ratio breaks down for very small chromosomes,[10–12] *i.e.*, when there is a wide range in chromosome length, but even in these cases long chromosomes have more chiasmata per bivalent than the short ones.

Studying cytologically a series of autopolyploid plants with various chromosome lengths, the following tendencies [4,13–15] have been found: (1) longer chromosomes form more frequently quadrivalent groups during the meiosis than the shorter ones. The very short ones usually do not form quadrivalent groups. (2) Autotetraploid plants, derived from species with long chromosomes, form quadrivalents more frequently (when the chromosome number is not too large) than tetraploids derived from species with short chromosomes; in other words the coefficient of quadrivalency

$$\left(\frac{\text{Number of the quadrivalents formed}}{\text{Number of the quadrivalents that can be formed}}\right)$$

is much greater in the former autotetraploids than in the latter. (It may vary from 1 to 0.) These tendencies are best interpreted on the pairing blocks hypothesis (Darlington) which also interprets the chiasma frequency in short and long chromosomes and chromosome arms, because quadrivalents result from chiasma formation in the paired segments of all four homologous chromosomes, presented in the autotetraploids. Most of the autotetraploids also form trivalents and univalents, parallel with bivalents and quadrivalents. Abnormal distribution of the univalents and the members of the trivalent and quadrivalent groups during the meiosis is one of the most essential causes for the reduction of fertility in autotetraploids and for their survival, because they lead to formation of disbalanced (in respect to the chromosome numbers) gametes. (A relative reduction of the velocity of the pollen tube growth especially of the disbalanced gametes is another factor that conditions reduced fertility.)

The degree of fertility is the most essential factor, that regulates the survival of the new tetraploid.

Allotetraploids, derived from F_1-hybrids with asyndetic meiosis (*I*) usually have normal meiosis (forming only bivalents, rarely univalents) and are highly fertile. Allotetraploids derived from F_1-hybrids with complete allosyndetic meiosis (*II*) behave very much like the autotetraploids forming bivalents, quadrivalents, trivalents and univalents and usually have, like them, somewhat (or highly) reduced fertility. Allopolyploids derived from F_1-hybrids with partial allosyndesis during the meiosis (*III*) occupy a position between the two extremes (*I*) and (*II*).

On the basis of the preceding statements we can logically deduce that autopolyploid forms derived from species with short chromosomes should survive better in nature, because they form more bivalents and less quadrivalents (trivalents too), than those derived from species with long chromosomes. Allotetraploids derived from F_1-hybrids with allosyndesis should behave in a similar way. Consequently, polyploid species in nature with long chromosomes of a higher degree of polyploidy would have most frequently an allopolyploid origin; F_1-hybrids from which such species have been derived should have, most probably, asyndetic meiosis or only partial allosyndesis. There is a relatively small chance for the survival of autotetraploid forms derived from species with long chromosomes and of allotetraploids with long chromosomes, derived from

F_1-hybrids with normal or high allosyndesis during the meiosis. Studying a series of polyploid forms existing in nature and experimentally produced, as well as the drawings of chromosomes in diploids and polyploids, made by other investigators, I obtained data which support strongly these deductions. Autopolyploid forms, with largest chromosome numbers found in nature are derived from species with small chromosomes. Such forms are, for example, *Silene ciliata* Pourr. with $2n = 24$, 48 and 192 chromosomes, *Dianthus sinensis* L. (*Seguieri* Vill.) with $2n = 60$ and 90 (*Dianthus superbus* L., — *arenarius* L., having $2n = 30$ and 60) chromosomes, etc. (*cf.* the list of the autopolyploids given by Müntzing[16]).

Autopolyploidy induced in plants with long chromosomes leads to high or complete sterility. *Triticum vulgare* autotetraploids[17,18] ($2n = 84$) produced by abnormal temperatures were self-sterile. Auto-octoploid *Tr. durum*, which I grew, was also self-sterile. Genus *Nicotiana* has much shorter chromosomes than *Triticum*. Autotetraploids *N. alata* ($2n = 36$) and *N. longiflora* ($2n = 40$), which I produced, by colchicine and acenaphthene were highly fertile, while the octoploid *N. alata* ($2n = 72$) was self-sterile. In other words, high polyploidy also reduces fertility.

I shall further consider a series of plants in which the species with large chromosome numbers have small chromosomes. Smith[19] (1937) studied the chromosome numbers in *Dioscoreaceæ*. His drawings show that *Dioscorea caucasica* ($2n = 20$) and *D. quinqueloba* ($2n = 20$) have large chromosomes, the species *D. reticulata* ($2n = 61$) and an undefined sp. ($2n = 40$) have medium chromosomes, while *D. batatas* ($2n = 144$) has small chromosomes. Similar regularity can be found in studying the drawings made by Baldwin[20] (1936) of the *Crassula* karyotypes. The species of the division *Turrita*, namely, *Crassula barbata* ($2n = 14$) and *C. hemispherica* ($2n = 14$) have large chromosomes, while *C. nodulosa* ($2n = 56$) has medium chromosomes. The species from other divisions, namely, *Crassula sarmentosa* ($2n = ca.\ 60$), *C. multicava* ($2n = ca.\ 112$) and *C. spatulata* ($2n = ca.\ 148$) have short chromosomes. The species of the genus *Griffinia* studied by Satô[20a] also represents an excellent example in this respect. In genus *Sedum*[21] no noticeable difference exists in the chromosome length of the species with small and with large chromosome numbers, they all have, however, short chromosomes. The chromosomes of diploid *Lobelia* species (*inflata, syphilitica, dresidensis*, $2n = 14$), as drawn by Okuno[22] (1937), have large chromosomes, tetraploid species *L. sessilifolia* ($2n = 28$) has medium chromosomes, and hexaploid species *L. Richardsonii, triquetra* and *Erinus* ($2n = 42$) have small chromosomes. *Geranium erianthum* ($2n = 30$) has long chromosomes, *G. Sanguineum* ($2n = 84$) has short chromosomes as the drawings of Sakai[23] (1935) showed. His[24] drawings also showed that diploid *Aconitum* species (*umbrosum* and *yuparense*, $2n = 16$) have longer and thicker chromosomes than tetraploid *A. sachalinense* ($2n = 32$) and *A. subcuneatum* ($2n = 32$). The drawings of Tanaka[25] (1937) showed that *Scirpus mucronatus* ($2n = 42$) has the largest chromosomes, *S. cyperinus* var. Wichurai ($2n = 66$) has medium and *S. Maritimus* ($2n = 110$)—the smallest chromosomes. But, in general, genus *Scirpus* has small chromosomes in comparison with *Triticum*, for example. Strekova[26] (1938) studied and drew the chromosomes of the genus *Alopecuros* (*A. æqualis*, $2n = 14$; *A. ventricosus*, $2n = 28$; *A. glacialis*, $2n = 56$; *A. borealis*, $2n = 98$). According to her drawings, *A. æqualis* ($2n = 14$) has the largest and the thickest chromosomes, while *A. borealis* ($2n = 98$)—the smallest and the thinnest. Delaunay[27] (1926) studied the chromosome number and size of *Muscari, Bellevalia* and *Ornithogalum* and found that species with smaller chromosome numbers have usually longer chromosomes, attempting at the same time to evaluate this statement, phylogenetically, though in a different aspect. Examining numerous drawings of the karyotypes of a large number of species of phanerogamous plants made by Matsuura and Sutô[28] (1935), one feels easily convinced that species with gigantic chromosomes have not large chromosome numbers. Such species are: *Hepatica triloba* ($n = 7$), *Anemone flaccida* ($n = 7$), *Diphylleia Grayi* ($n = 6$), *Trautvetteria japonica* ($n = 8$), *Achlys japonica* ($n = 6$), *Sironema fragrans* ($n = 6$), *Hyacinthus orientalis* ($n = 8$), *Disporum sessile* ($n = 8$), *Aloe* sp. ($n = 7$), *Gesteria* sp. ($n = 7$), *Howarthia* sp. ($n = 7$), etc. It should be noted that all species of *Howarthia*[29, 30] hitherto studied are diploids ($2n = 14$). No polyploid *Lilium* species have been yet found, the whole genus having long ($n = 12$) chromosomes. Genus *Dianthus*, on the other

hand, has very small chromosomes and according to the data of Blackburn and those of Rohweder (*cf. Tischler*,[31] 1931) 25 species have $2n = 30$ chromosomes, 9 species have $2n = 60$ chromosomes and 11 species have $2n = 90$ chromosomes. The species *D. plumarius* has $2n = 30$ and 90 (Rohweder) and species *D. prolifer* has $2n = 30$ and 60 chromosomes. *Betula*[32] and *Populus*[33] have small chromosomes; *Betula* species having $2n = 28$, 56, 84 and even 90 chromosomes, and *Populus* species: $2n = 38$ and 57 chromosomes. The species *Betula japonica* has $2n = 28$ and 56 chromosomes. *Fragaria*, *Viola* and *Campanula* species also have relatively small chromosomes. *Fragaria*[31] has a polyploid series between $2n = 14$ and 84. The smallest chromosome number in *Viola* is $2n = 12$, the largest $2n = 96$. The species of the genus *Campanula*[31] have $2n = 16$, 32, 34 and 102 chromosomes. In *Gramineæ* there are genera with long chromosomes (*Triticum*, $2n = 14$, 28, 42; *Secale*, $2n = 14$; *Ægilops* $2n = 14$, 28, 42, etc.) and genera with shorter chromosomes (*Leersia*,[34] *Ehrharta*,[35] *Saccharum*,[36,37] *Setaria*, etc.). *Secale* species are only diploid. The polyploid species of *Triticum* and *Ægilops* have $2n = 28$ and 42 chromosomes, all of them being allopolyploids. New allopolyploid forms with $2n = 56$ have been experimentally produced, but they usually have somewhat reduced fertility. In the genus *Leersia*[34] on the other hand, the following chromosome numbers were reported by Hirayoshi[34] (1937): $2n = 48$ (*L. hexandra*), $2n = 60$ (*L. oryzoides* and $2n = 96$ (*L. japonica*). In *Saccharum*, species with $2n = 60$, 80 and with 112 (*S. spontaneum*) chromosomes have been reported by Bremer. *Setaria* species have $2n = 18$, 36 and 72 chromosomes (Kishimoto, 1938). The species *Agropyrum elongatum* ($2n = 70$) has relatively long chromosomes and, at the same time, a large chromosome number. The cytogenetic investigations showed, however, that this decaploid species is most probably allopolyploid, at least in respect to four genoms, only one being perhaps presented twice; the most reliable genom formula of it being AA BB CC X_1X_1 X_2X_2. *Narcissus dubius* ($2n = 50$) represents a similar case. It has the largest chromosome number of this genus. All *Narcissus* species have long chromosomes. Cytogenetic studies by Fernandes[39] (1937) showed that this species is an auto-allopolyploid having two genoms of *N. juncifolius* ($2n = 14$) and one genom of *N. tazetta* ($n = 11$), the genom formula of *N. dubius* being $\frac{JJT}{JJT}$. Cytogenetic studies also showed that *Helianthus*[38] *tuberosus* ($2n = 102$) is most probably an allo-autopolyploid having a genom formula $\frac{At_1\,At_2\,Bt}{At_1\,At_2\,Bt}$, the genom Bt being closely related to *Helianthus annuus* ($2n = 34$) genom. But *H. tuberosus* still has abnormalities during the meiosis and reduced fertility. If this species does not propagate vegetatively it hardly would survive. It has medium chromosomes.

The mode of propagations (vivipary) seems also to "protect" high polyploidy in some alpine and arctic plants (grasses). It seems that low temperatures (especially at night) favour polyploidy. At low temperature the chromosomes become shorter thus offering smaller segments for conjugation and for chiasma formation. Cold reduces pairing and chiasma formation. This is most probably due to an increase in the cytoplasmic viscosity and shortening of the chromosomes.

I shall also consider here the long list of chromosome numbers recorded by Sutô[40] (1936) in *Liliaceæ* and *Amaryllidaceæ*. It is not very suitable for our studies because no drawings were given, but nevertheless, he classified the karyotypes into four groups which fit generally quite well to the general principles here outlined. Idiograms of the type *Yucca—Agave* (4–5 long + n dots) were designated YA; further TD = *Tofieldia—dracœna* (n dots); LN = *Lilium—Narcissus* (n longs); and UP = *Uvularia—Polygonatum* (m longs + n dots). Species with large chromosome numbers have most frequently idiograms TD and YA (*Hosta, Drimiopsis, Yucca, Cordyline, Dracœna, Sanseviera, Agave, Fourcroya, Beschorneria, Polyanthus*).

One can also conclude from the drawings made by Hagerup[41] (1938) that there are species in genus *Orchis* with large (*O. maculatus* var. *Meyeri*, $2n = 40$; *O. ustulatus*, $2n = 42$) and such with small chromosomes (*O. purpureus*, $2n = 42$; *O. sambucinus*, $2n = 42$; *O. incarnatus*, $2n = 40$). The polyploid forms, *O. latifolius* ($2n = 80$) and *O. maculatus* var. *genuinus* ($2n = 80$), however, have small chromosomes. The case with *O. maculatus* shows that a crowding of the chromosomes in the polyploid form is connected with somewhat smaller size of the chromosomes. Such a conclusion

might be premature, especially when it is drawn from polar views of meiotic chromosomes. Examining, however, the size of the somatic chromosomes of diploid *Artemisia borealis* ($2n = 18$) in respect of those of the tetraploid variety *bottnica* ($2n = 36$) drawn by Erlandsson[42] (1939), I think that such a tendency does exist. Variety *bottnica* has somewhat smaller chromosomes. In comparing the chromosome size of diploid and octoploid *Nicotiana alata*, I had the same impression, namely, that the octoploid species had somewhat thinner and shorter chromosomes than the diploid one. There is a very striking difference in the chromosome size between those of *Plantago lanceolata* var. *altissima* from Bucharest ($2n = 12$) and those of *P. lanceolata* var. *altissima* from Munich ($2n = 96$), studied by McCullagh,[43] the chromosomes of the diploid form ($2n = 12$) being about 4 or 5 times larger in size than those of the *16-ploid*.

It seems that hydration (viscosity degrees) and nutrition processes (*i.e.*, differences in amount of substances, present in the nucleus, resp. passing through the nuclear membrane, necessary for chromosome growth and reproduction in polyploid large nuclei, where the chromosomes are more crowded in comparison with those of the diploids, where they are less crowded) are responsible for these differences in degree. It should be pointed out here that smaller nuclei, typical for the diploids, can be better supplied by the cytoplasm with substances necessary for the growth and reproduction of the chromosomes than the large polyploid nuclei, since the former nuclei have larger surface in relation to their volume than the latter. The decrease of the ratio $\frac{\text{nucleus surface}}{\text{nucleus volume}}$ with the euploid increase of the chromosome numbers is probably the main factor that suppresses the frequency of the cell division in high polyploids. Octoploid *Nicotiana alata* ($2n = 72$), for example, has larger nuclei and larger cells than the tetraploid ($2n = 36$) and diploid ($2n = 18$) *N. alata*, it was, however, smaller in size, *i.e.*, it had much smaller number of cells. Our more recent observations also suggest that the decrease in the $\frac{\text{nucleus surface}}{\text{nucleus volume}}$ ratio with the euploid increase of the chromosomes in plants regulates the change in the leaf index (a decrease of $\frac{\text{length of the leaves}}{\text{breadth of the leaves}}$ with the euploid increase of the chromosomes).

In the trend of this discussion I shall call attention to the better survival of polyploids than of diploids with some chromosome deficiencies (deletions), which also lead to differentiation of karyotypes with some shortened chromosomes. This process might often occur during the chromosome differentiation (genic and structural) of the newly raised polyploids until they change from plants with multivalent chromosomes during the meiosis into plants with bivalent chromosomes.

Some cytogenetic data suggest that the chromosome size is under genic control.[4] It does not seem improbable, that some polyploids have survived, because they are mutants with short chromosomes. A too great crowding of chromosomes in polyploids of higher degree, especially when the latter are large and even medium in size also interferes with the meiotic processes. Autotetraploids *Nicotiana alata* ($2n = 36$) and *N. longiflora* ($2n = 40$), for example, have a much normal meiosis and higher fertility than the autotetraploid forms of *N. rustica* ($2n = 96$) varieties. The latter varieties set only on the average 10 to 25% of seeds. It should be pointed out that *N. rustica* is an allopolyploid species its haploid forming usually 0-1 bivalents. One of the essential factors for the reduction of fertility in high polyploids is obviously the reduction of the ratio $\frac{\text{average diameter of the pollen mother cells}}{\text{average diameter of the meiotic equatorial plates}}$ with the euploid increase of the chromosomes. This ratio for *N. rustica* diploid is 1·783 and for *N. rustica* tetraploid —1·496. Another important factor that is responsible for some abnormalities during the meiosis is the size of the leptotene nuclei. High polyploids are more likely to form less quadrivalents (proportionally) and more univalents, because the chromosome pairing attraction should be inversely proportional to the square of the distance between the chromosomes at leptotene. If two homologous chromosomes occupy diametrically opposite positions in a very large polyploid nucleus, their pairing attraction might be so reduced that they may fail to pair. It seems quite logical that the crowding itself of the chromosomes in polyploids with large chromosome numbers would reduce pairing and chiasma formation. Insignificant external conditions that interfere with the meiotic processes (temperature, viruses, etc.) would induce in such high polyploids greater meiotic disturbances than in plants with smaller nuclei.

Preceding considerations of the significance of chromosome size and number are of importance from a practical point of view. It might be suggested that polyploids (especially autopolyploids) when produced for practical purposes should be better derived (when possible) from plants with smaller chromosomes (in size) and with smaller chromosome numbers.

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Professor J. C. Ghosh, D.Sc., F.I.C., F.N.I.

(*Director, Indian Institute of Science, Bangalore*)

THE news of the appointment of Professor J. C. Ghosh as Director of the Indian Institute of Science will, we are confident, be received with generous enthusiasm both in India and abroad, and we have pleasure in offering him our warmest felicitations on his elevation to what we regard as the Pontifical Chair in the realm of Indian Science. It will be recalled that as the Head of the Department of Chemistry in the Dacca University, his strenuous labours have established a flourishing school of chemical research, whose contributions have as much significance in the field of theoretical knowledge as they have important practical applications in industry. Professor Ghosh's achievements have brought him blushing honours, thickly and surely. He was one of the organising members of the Indian Chemical Society of which he became

President in 1924. He was one of an aggregate of a hundred eminent scientists who assisted at the birth of the National Institute of Sciences. The coveted distinction of President of the Indian Science Congress came to him in 1938. As a member of the Advisory Board of the Imperial Council of Agricultural Research and of the Governing Body of the Indian Research Fund Association he rendered conspicuous service. His eminence as a research worker in the field of pure and applied branches of chemistry and soil science was recognised by his appointment as a member of the National Planning Committee. Such gifts, at once rich and varied, he now proposes to dedicate to the service of the Institute, whose resources and facilities ought to furnish him with opportunities for inaugurating new lines of scientific and industrial research, which would bring credit to him and enrich the traditions of this great foundation. Professor Ghosh has an arduous task before him, and on the eve of initiating it, we offer him our best wishes for unmixed success.

Rao Bahadur Professor B. Venkatesachar, M.A., F.Inst.P., F.N.I.

ON the eve of relinquishing his office as Officiating Director of the Indian Institute of Science, we have great pleasure in offering Rao Bahadur Professor B. Venkatesachar our warmest wishes for a happy and contented life in his retirement. He was summoned to occupy the Director's post under the stress of circumstances prevailing in 1937, which he accepted purely in a sense of disinterestedness and in a spirit of patriotic service. During the two years in which he administered the affairs of the Institute, his efforts were generously understood and greatly appreciated. In a way he felt called upon to play the rôle of John the Baptist, making things smooth and easy for his successor to continue the work which Professor Venkatesachar had laboured hard to stabilise. We wish him many long years of happiness and usefulness.

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The Ultra-Violet End of the Solar Spectrum

It is well known that the solar spectrum as observed at the earth's surface is cut off suddenly towards the ultra-violet at about 3000 A and that this is due to the presence of ozone in the earth's atmosphere. Dobson's ozone survey (1928–29)[1] and recent measurements made (in 1936–38) at Bombay[2] clearly show that smaller amounts of ozone (about 0·200 cm. at N.T.P.) occur over the tropics than over higher latitudes. In the light of these results of ozone measurements, the best places for a further attempt at extending the ultra-violet limit of the solar spectrum would be the tropics. Fabry and Buisson[3] in Marseilles reached 2885 A, while Götz[4] in Arosa has been able to observe the spectrum up to 2863 A. However no photograph of the spectrum has been published beyond 2912 A. The best published photographs are due to Fabry and Buisson (1921). (Please see Fig. 2 for a reproduction.) These photographs were obtained by means of a double spectrograph of quartz; the authors varied the time of exposure in different portions of the spectrum according to the intensity of the

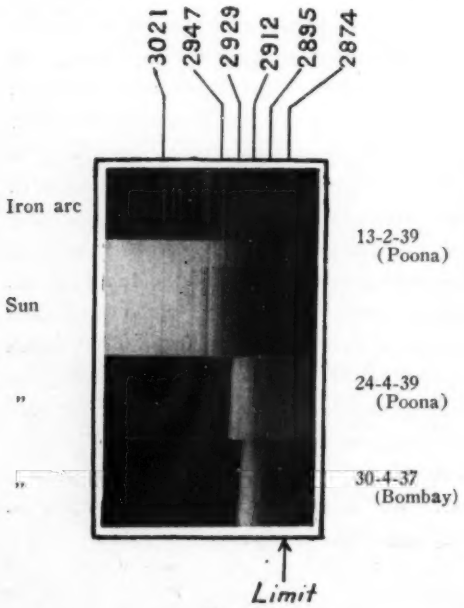

Fig. 1

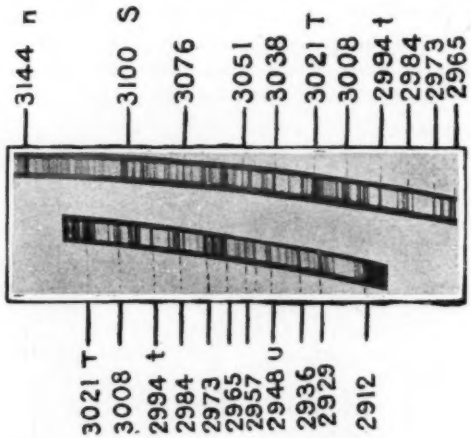

Fig. 2

[From Fabry and Binsson, *Astroph. Journ.*, 1921, 54, 297.]

spectrum there. Götz also used a powerful double spectrograph and long exposures.

The present attempt was made at Poona to find the limit that could be reached (latitude 18° 32′ N.) with a simple Dobson's spectrograph. To cut off the brighter portions of the spectrum a chlorine-bromine filter was used. The instrument was adjusted to photograph the u.v. spectrum in the region 3300 A to 2840 A only. For the present purpose, the optical wedge which is usually placed in front of the photographic plate, was removed and unwanted portions of the spectrum and also the light scattered in the instrument were meticulously eliminated by pasting black paper in different parts of the instrument. A composite picture, with the spectrum of an iron arc superposed on one of them, is reproduced here. These pictures were not taken on the same day but are only placed side by side accurately. During April and May, when the sun is nearly overhead in these latitudes and the skies are perfectly clear at noon, one can photograph the spectrum, on any day, up to about 2900 A with an exposure of 10-15 mins. on an Ilford special rapid or similar plate. On the 24th April 1939, the limit reached was 2895 A; while on the 30th April 1937, exposed under similar conditions at Bombay (latitude 18° 54′ N), 2874 A was reached. Here also, the intensity of the region beyond 2895 A is extremely small and reproduction is not possible.

In order to bring out the very faint lines recorded beyond 2912 A, intensity measurements were made with a Skinner-Dobson microphotometer of the plate exposed on the 30th April 1937. These are shown in Fig. 3. Although the curve shows some lines near 2863 A, extension of the spectrum so far is not beyond doubt.

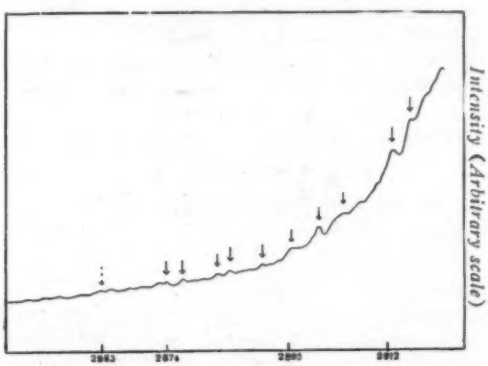

FIG. 3.

In spite of the great care taken to avoid scattered light reaching the plate, small traces could not be avoided owing to the imperfection in the prism and reflecting mirror. This light was sufficiently strong to drown the extremely weak short wave-length region; and exposures longer than 15 mins. could not bring out any further detail. For the present, therefore, 2874 A is the limit that can be attained with this instrument; and for further extension, which does not seem impossible, a double spectrograph and longer exposures must be tried.

I am very thankful to Dr. K. R. Ramanathan for his guidance and Dr. D. D. Karve of the Furgusson College for allowing me the free use of his laboratory.

M. W. CHIPLONKAR.

Poona,
June 16, 1939.

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A Case of Variegation in *Capsicum annuum* L.

IN the March issue of the *Journal of Heredity* a case of variegation in *Capsicum* has been reported by Cochran.[1] A similar case has been observed by me at the Botanical Section, Imperial Agricultural Research Institute, New Delhi.

In the first week of August 1938, a variegated seedling (Fig. 1) was noticed among the progeny raised from the mixed seeds of non-bagged plants of the chilli variety, Pusa Type 51 (for its description please see Shaw and Khan,

FIG. 1

1928).[2] The leaves on one side of the main shoot, starting from the sixth node, were variegated and those up to the fifth node, as well as on the other half of the main shoot, were normal green. The proportion of green, yellowish green, yellow or white areas forming the variegation in these leaves, varied.

The branches arising out of the axils of variegated leaves were entirely variegated and those from the axils of green leaves were green. The pedicels and calyx lobes of flowers on the variegated branches had faintly marked bands of pale green and yellow colour running longitudinally. In the unripe fruit also, similar bands radiating from the apex to the base, could be seen, the apex being almost entirely yellow or creamy.

Some of the variegated and normal green branches were selfed separately and also crossed reciprocally.

The selfed seeds of fruits from the normal green and variegated branches, as also those of the crosses, were sown in May 1939. The cotyledonary leaves in all cases were normal to start with, but in the case of the progeny of the variegated branches, they quickly turned yellow and the seedlings died within four or five days after germination. The progeny of normal green branches as well as the hybrid seedlings are normal green.

The variegated portion of the plant, which is chimerical (sectorial) in nature, appears to have arisen as a bud mutation. The component parts, green and variegated, forming the chimera, breed true, the progeny from the latter, however, being incapable of independent existence due perhaps to the deficiency of chlorophyll or through being associated with a lethal factor. The normal green condition is dominant over the chlorophyll deficient condition in F_1 and in F_2 a 3 : 1 segregation is expected in which the recessives are not likely to survive.

This case is thus parallel to the one reported by Cochran, the only difference being that whereas in the latter case the fruits on the variegated branches dropped before reaching maturity, in my plants the setting was normal. Had Cochran tried to cross the two types of branches, instead of waiting to effect crosses between their respective progenies, it is likely that he would have been successful in making at least a one-way cross, *viz.*, green × variegated.

R. B. DESHPANDE.
Imperial Agricultural Research Institute,
New Delhi,
July 4, 1939.

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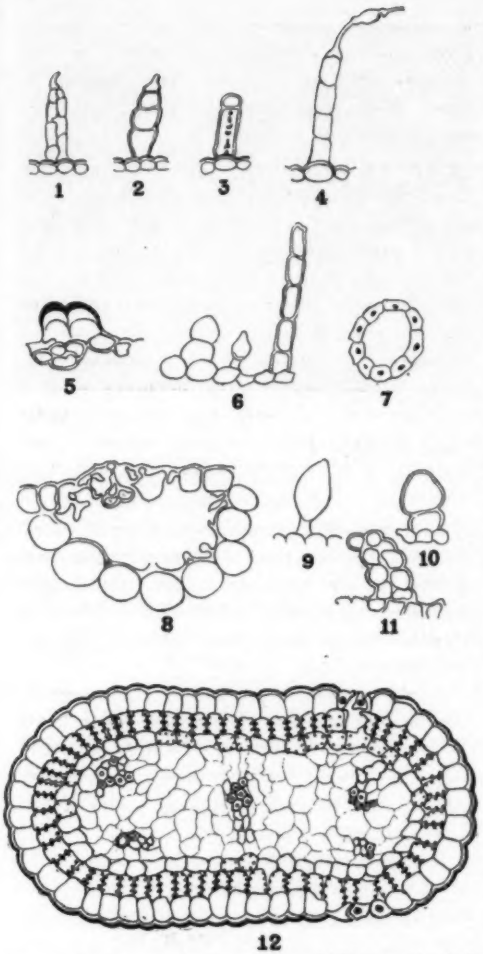
On the Anatomy of Some of the Compositæ

IN the following article the authors have recorded their observations in brief on the anatomy of three Compositæ, namely, *Vicoa auriculata* Cass., *Grangea maderaspatana* Poir., *Glossocardia linearifolia* Cass. All the three are very common in Hyderabad, and grow under more or less xerophytic conditions on gravelly and rocky soil. This investigation was taken up



FIGS. 1–7. *Vicoa auriculata* Cass.—(1) Biseriate conical shaggy hair; (2) Uniseriate conical hair; (3) 2-celled cylindrical hair; (4) Long multicellular hair; (5) Glandular hair on the stem; (6) Pear-shaped and ordinary multicellular hairs; (7) Resin canal. All × 250.

FIG. 8. *Grangea maderaspatana* Poir.—Secretory cavity with papillose differentiation of the epithelium. × 250.

FIGS. 9–12. *Glossocardia linearifolia* Cass.—(9) and (10) Pear-shaped trichomes; (11) Curved multicellular biseriate trichome; (12) T.S. leaf, showing stomata, thick cuticle, broad layer of epidermal cells, palisade tissue and vascular system. All × 250.

because, owing to the vast scope of this family, our knowledge of the anatomical features is still imperfect. It is proposed to deal with these plants separately.

1. *Vicoa auriculata* Cass.

The hairy covering in the stem consists of biseriate or multiseriate broadly conical shaggy hairs with a small pointed terminal cell (Fig. 1), uniseriate hairs with a conical terminal cell (Fig. 2), 2-celled cylindrical hairs (Fig. 3), and long multicellular trichomes with broad basal cells and with long constricted and pointed terminal cells (Fig. 4). Yet another type of hairs occurs. These glandular hairs possess hardly any stalk, and consist of four cells arranged in two rows (Fig. 5). In the leaf besides the ordinary hairs, peculiar bladder-like or pear-shaped trichomes also occur, although very scantily (Fig. 6). Oxalate of lime is excreted in the form of rhomboidal crystals in all parts of the plant.

Resin canals occur both in the stem as well as in the root (Fig. 7). In the former they are endodermal and are opposite the vascular bundles, but in the root they are endodermal as well as cortical. Resin canals are wanting in the leaf. Finally the occurrence of hard bast at both ends of the vascular bundles may also be mentioned.

2. *Grangea maderaspatana* Poir.

The hairy covering is very scanty and consists of multi-cellular trichomes like those described in the case of *Vicoa*, but some of them are bent at an angle to the stalk.

Oxalate of lime occurs in the form of very minute octahedral crystals.

The chief feature of the stem is the occurrence of secretory cavities with papillose differentiation of the epithelium in the cortex (Fig. 8). They are absent from the root. In the anatomical structure of the stem the poor development of hard bast as compared to that of *Vicoa* is striking.

3. *Glossocardia linearifolia* Cass.

The hairy covering consists of shortly-stalked pear-shaped trichomes (Figs. 9 and 10), and curved multicellular biseriate trichomes (Fig. 11).

The root is devoid of any hair covering. Oxalate of lime occurs in the form of octahedral crystals, those in the root being smaller than those in the stem and leaf.

Resin canals without any epithelial cells occur in the cortex of the root. They are not seen in the stem.

Leaves are 2-pinnatisect with linear apiculate segments. Stomata are present on both the surfaces, but are in greater numbers on the lower. They are surrounded by three or more ordinary epidermal cells. Large epidermal cells form a thicker layer than the palisade tissue. A marked xerophytic character is the presence of thick cuticle (Fig. 12).

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M. MOINUDDIN.

Department of Botany,
Osmania University,
Hyderabad (Dn.),
June 29, 1939.

Leaf Crinkle—A Transmissible Disease of Papaya

IN the course of raising papaya (*Carica papaya*) seedlings in the Mycologist's pot culture house at Coimbatore, the authors came across a few seedlings which showed definite symptoms of a disease, which they believe has not been described before. The symptoms are: The stem instead of growing erect assumes a slightly zigzag appearance. The leaves are slightly crinkled and the lobes of the palmatifid lamina curve downwards and inwards and the entire leaf assumes the shape of an inverted cup (Fig. 1). On the underside of the leaves the veinlets are thickened, slightly gnarled, dark green in colour and opaque when held against the light. The seedlings which show symptoms of the disease grow without appreciable stunting in growth and continue to exhibit the symptoms throughout. When pollarded such seedlings give rise to leaves which show the characteristic symptoms. Examination of roots, stem and leaves did not show the presence of any associated organism, nor was there any indication of any insect infestation.

FIG. 1

Left: Healthy plant. *Right:* Infected plant. The disease having been transmitted by grafting (photographed eight weeks after the first symptoms were noticed).

With a view to finding out if the disease is transmissible, seedlings showing symptoms were grafted to six perfectly healthy seedlings by the inarching method. Symptoms developed on three of the grafted plants within a period of 120 days.

A photograph of a normal plant and one showing the disease accompanies this note.

K. M. THOMAS.
C. S. KRISHNASWAMI.

Agricultural Research Institute,
Coimbatore, S. India,
June 10, 1939.

Discovery of a Species of *Coeloplana* Commensal on the Star-fish *Pentaceros hedemanni* in the Sea off Krusadai Island, Gulf of Mannar[1]

WHILE going through the literature on species of *Cœloplana* with reference to the species recently discovered by Prof. W. M. Tattersall,[2] the Assistant Director Dr. D. W. Devanesan and I had occasion to peruse Dr. Mortensen's paper on "Two New Ctenophores" wherein he has described *Cœloplana astericola*, a commensal on a star-fish *Echinaster luzonicus*.

On 23rd February 1939, while collecting specimens of the star-fish *Pentaceros hedemanni*

common round Krusadai Island, I noticed red patches on their bodies. When detached and examined under the microscope, they were found to be clusters of a species of *Cœloplana*. Dr. Devanesan who examined them on the 10th March 1939 is also of the opinion that their organisation and the presence of the two long tentacles with their uniserial branches left no doubt that they were *Cœloplanæ*. As they are uniformly red, they seem to be different from *Cœloplana astericola* Mortensen, which is said to be mottled red and white. Dr. Devanesan and I are continuing our observations on this new species of *Cœloplana* and hope to be able to publish ere long a brief account of its structure and habits.

S. VARADARAJAN.

Marine Biological Station,
Krusadai Island,
Gulf of Mannar,
June 16, 1939.

[1] Published with the permission of the Director of Fisheries, Madras.

[2] *Curr. Sci.*, 1939, 8, 157.

A Note on the Biology of *Lucilia sericata* Meigen (*Calliphoridae, Diptera*) in Baluchistan

Lucilia sericata Meigen (Family Calliphoridæ, Order Diptera), the larvæ of which cause cutaneous myiasis in sheep skin is a species of great economic importance. Its attack is particularly severe in Europe, North America, South Africa and Australia. In India it has previously been recorded by Sinton (1921) and Patton (1922), the adults having been bred from cases of human cutaneous myiasis in the North-West Frontier Province. Last year the writer reported the occurrence of this sheep blowfly causing cutaneous myiasis in sheep in Baluchistan (Janjua, 1938). A study of this pest undertaken in the beginning of 1937 has revealed some interesting facts about its biology and these are recorded in this note. The identification of the species has been done by the Imperial Institute of Entomology, London, to whom I am grateful for the help rendered.

Sheep farming is one of the principal occupations of the people of Baluchistan as the area of pasturage is unlimited and the hillsides and valleys of the Province are covered with grass and other succulent plants which afford excellent grazing for sheep. But the presence of *Lucilia sericata* is causing a grave concern to the sheep farmers of Baluchistan. As a result of investigations carried out by the writer for the last three years it has been ascertained that about 20–25 per cent. of the sheep in the Quetta-Pishin, Loralai and Zhob districts of the Province are under the attack of the maggots of this fly.

The sheep attacked by the fly is easily noticed with its head bent down and not feeding normally. It is irritable, uneasy, constantly shaking and when feeding, is frequently seen to stamp one hind leg. The diseased sheep has the habit of looking back over the shoulder and wagging its tail in a characteristic manner. During rest it avoids sun and seeks the nearest shady place. The wool on the affected part shows a dirty greyish-black stain and closer examination reveals a sticky fluid with a peculiarly offensive odour. The maggots of the fly feed in the wool and the adjacent skin, causing the latter to fester and the wool to loosen and become putrid, thus exposing the inflamed flesh with the whitish maggots tunnelling into it. The injuries gradually become transformed into serious ulcers with great loss of tissue. There is a rapid loss of condition and invariably death follows.

The female flies are usually attracted to the sheep after a shower of rain during the rainy season by the odour arising from the fleece. The eggs are then laid in the wool and the maggots on hatching cause lesions in the skin. Any wound, however small, is an added attraction and sheep affected with foot-rot or those with shoulders and loins denuded of wool by rubbing or biting are frequently attacked.

The female deposits her eggs in clusters of from fifteen to twenty-seven and as many as two hundred eggs may be laid at one time. A single female during her life-time may lay about 1,000 eggs. The eggs are mostly laid on

wool which is wet with fæces or urine, the soiled hind quarters of the sheep being especially attractive to the flies. The wounds left on the body of the animal after shearing are also the common places where eggs are laid.

The egg (Fig. 1) is white and somewhat sausage-shaped. It is 1·3 mm. long and 0·39 mm. broad. The incubation period at different times in the seasons varied from 10 hours to 40 hours.

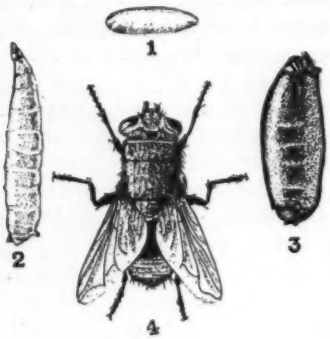

FIG. 1

FIG. 1.—Egg. × 11·5.
FIG. 2.—Larva. × 3·5.
FIG. 3.—Pupa. ×3·5.
FIG. 4.—Adult (female). × 3·5.

The maggot on hatching bores into the skin by means of sharply pointed mouth parts. They are found in squirming masses in the affected skin. During feeding they emit a slimy fluid which is chiefly responsible for the soiled appearance and rotting of wool in the infested patches of skin.

The full grown maggot (Fig. 2) is glistening white and 14 mm. to 16 mm. long and about 3 mm. broad. The mandibular hooks of the mouth parts at the anterior end are curved inwards and strongly chitinized. The anterior spiracles are provided with rings of spines which assist in locomotion. The body is cylindrical, slightly flattened dorso-ventrally, broad in the posterior region and is gradually narrowed towards the anterior end of the head. Besides the conical head there are eleven apparent segments—three thoracic and eight abdominal. In the intersegmental regions there are girdles of spines assisting the maggot in creeping through the skin. The larval period during the season varies from 5 to 11 days. When fully fed the maggot crawls away from the body of the sheep and drops to the ground where it burrows into the earth and remains as such before turning into a pupa. They are usually found within a depth of ¼ inch in the soil in an earthen chamber formed by caking of the soil. The prepupal period varies from 3 to 16 days during summer but this period is prolonged during the winter as hibernation takes place in this stage. The prepupæ are found at depths from 6 to 12 inches in winter and migrate to the surface during March next to turn into pupæ. The duration of the hibernating prepupæ ranged from 137 to 162 days.

In other sheep-rearing countries the mode of hibernation of *Lucilia sericata* varies. In South Africa the fly passes the winter in all stages except as egg and breeds continuously throughout the year (Smit, 1929). In New South Wales it is present at all seasons of the year (Gurney and Woodhill, 1926); in the United States it overwinters in the larval and pupal stage (Bishopp, 1916) while in New Zealand it strikes the sheep throughout the winter (Miller, 1921).

During pupation the body of the prepupa contracts as a whole, the anterior segments are entirely withdrawn and the anterior spiracles although occupying the same position as in the larva, lie at the anterior end of the body. The pupa (Fig. 3) is of a rich dark brown colour and is 8 mm. to 9 mm. long and 3·35 mm. broad. The duration of the pupal period during summer varied from 15 to 21 days and 28 to 33 days in spring.

When about to emerge, the fly, by means of a pulsating bladder-like organ on the front of its head, makes a circular slit at the anterior end of the pupal case and this cap-like portion is usually split into two halves by two lateral slits running forwards horizontally and meeting at the anterior end.

The adult fly (Fig. 4) on emerging is very soft and makes its way to some sunny spot where it spreads its wings and raises them up and down to facilitate drying. After a few hours the body and wings dry and the colours of the body become evident. For the description of the adult fly reference may be made to Patton and Evans (1929).

Mating takes place within five or six days after emergence and oviposition occurs within a day or so after copulation. The longevity of the flies under laboratory conditions ranged from 25 to 55 days. There are four generations of the fly each year; the first generation beginning from the end of March to the middle of May; second from the beginning of June to the middle of July; third from the beginning of August to the end of September while the maggots of the fourth generation overwinter in October and flies emerge out of them in March next.

The duration of the various stages in the life-history is summed up as follows: Egg, 0·30–0·40 days; Larva, 5–11 days; Prepupa, 3–16 days during summer and 137–162 days in winter; Pupa, 15–21 days during summer and 28–33 days in spring and Adult fly, 25–55 days.

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Baluchistan,
Quetta,
June 21, 1939.

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Surface Structure of Polished Iridescent Shells

ELECTRON diffraction pictures were taken from the polished surfaces of the following iridescent shells:—

(1) *Lamelliderns marginalis*, (2) *Turbo*, (3) *Haliotis*, (4) *Nautilus pompilius*, and (5) *Margaritefera vulgaris*.

30 k.v. Electrons were used. The grinding and polishing were done with wet emery powder. The pictures show one or two diffuse rings, corresponding to a liquid or amorphous state. Thus it appears that here the process of polishing has converted the laminar body structure of the iridescent shells into an amorphous one.

In this connection it is worth recording that these shells in the polished state have been examined optically by Sir C. V. Raman[1,2,3] and by X-rays by Rama Swamy[4,5]; they find that in many cases the crystals of aroganite are arranged with considerable regularity so as to build up a laminated structure of nacre. The pieces of shells which are optically examined were about 0·1 mm. thick, and even here a body structure is observed. Thus the present work again shows that the electrons are even more suited for the examination of the surface structure than light.

This work was carried out in the Physics Department of the Indian Institute of Science, and my thanks are due to Sir C. V. Raman, for his kindness in placing the facilities of his department at my disposal.

K. R. DIXIT.

Gujerat College,
Ahmedabad,
June 12, 1939.

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[4,5] Rama Swamy, S., *ibid.*, 1935, **1**, 871 and 1935, **2**, 345.

REVIEWS

Tabelle der Hauptlinien der Linienspektren aller Elemente nach Wellenlänge geordnet. By H. Kayser. Second Edition, revised and enlarged by R. Ritschl. (Julius Springer, Berlin), 1939. Pp. viii + 269. Price 28·50 RM.

It is now thirteen years since the first edition of this indispensable table of Spectral Lines, compiled by Prof. H. Kayser appeared. Very soon after that date Spectroscopy grew apace at such a tremendous rate that within half-a-dozen years it reached a turning point in its development. We may now say that the interest of the scientific world which had been concentrated on the results of Spectroscopy since the advent of Bohr's theory has definitely shifted elsewhere, particularly to Nuclear Physics. But important advances have not been lacking in Spectroscopy in these years. Improved photographic materials have extended the region in the infra-red available to that technique; in the vacuum ultraviolet the advance has been still more remarkable, for now the gap between optical and X-ray spectra has been bridged. To take stock of all these developments and to make Prof. Kayser's book a faithful mirror of the same has been the task which has fallen on the worthy shoulders of Dr. Ritschl. The way he has discharged the onerous responsibility leaves little to be desired. The peculiar excellence of Prof. Kayser's book was the exhaustive and critical sifting of the available material that engendered such absolute confidence in its authority. Dr. Ritschl has also succeeded in keeping very close to this tradition. He has taken into account all the available literature and produced a book which faithfully reflects the present state of the science. Whereas Kayser's original Table in the sixth volume of his *Handbuch* devoted 5½ pages to the wave-lengths down to λ 7000 A.U. and stopped short at about λ 2000, the present Table has 32½ pages for the region down to λ 7000 A.U. and 38 pages are devoted to wave-lengths below 1600 A.U. The entries reach down to 32 A.U. Another marked improvement is that now most of the listed lines are definitely assigned to various stages of ionization. In its new edition, we are quite sure, the book will continue to render yeoman service, as only befits its pedigree.

A few remarks however seem to be called for regarding the sifting of the material that is so essential a part of the editorial responsibility in such a work. Regarding the wavelength data, the latest and best measurements have been utilised and since at present most authors do not differ except perhaps in the second place of decimals, there is little inconvenience in the fact that different observers have furnished the data accepted as authoritative in various parts of the same spectrum. But when we come to the question of intensities, there is an insuperable difficulty. Conditions of excitation are so various, and the intensity estimates of different observers are so markedly different and expressed also on such different scales that to adopt a uniform numeration for the whole of the material is an almost impossible task. And yet this is exactly what is most necessary in a table such as the one before us. Unfortunately Dr. Ritschl has decided to adopt the numbers furnished by the authority he has elected to follow, but since for different parts of the same spectrum or even for different lines observed in the same part of a spectrum under different conditions, different authorities have had to be relied upon, it is quite impossible to get a correct estimate of the relative intensities of two lines of the same spectrum even though they may not be distant more than 1 A.U. from each other. When such a table as the one under notice is to be used in identifying a spectrum or some part of it or even more so in quantitative spectrum analysis, this non-uniformity makes it very difficult to spot the lines or estimate the composition of their source. If at least all the lines measured by one observer and admitted into this book from his list had a label such as his initials to indicate the fact, this difficulty would not be so great. As it is, some wave-lengths taken from the old edition or from one particular observer have the same tabulated intensity in this edition also, but other intervening lines, if they happen to have been recently remeasured or measured by a different observer, carry intensity numbers quite impossible to compare with the others. Either all relative intensities, at least of neighbouring lines, should be brought down to a uniform scale, or some indication must be given regarding those relative intensities

which are comparable among themselves. The device of quoting alongside a line the next line observable under the same conditions may be another way out of the difficulty. Another point, brought out by a comparison of the present table with the original sources in a few typical instances, is that in one part of the spectrum even the strongest lines belonging to a certain stage of ionization have been omitted, while in other regions even less intense lines of the same ion are included. But, in practice, if the weak lines of a certain ion appear under any circumstances of excitation, the stronger lines of the same ion are bound to be present also. The absence of the latter from the table would thus be misleading. A further fact is also puzzling: it is that most of the numbers given in the present Table down to λ 9000 as being expressed in International Angstroms coincide completely with those given in Kayser's original Table (*Handbuch der Spectroscopy*, Vol. VI) and there expressly stated to be on Rowland's scale. The two scales however differ from each other sufficiently to make this coincidence ununderstandable. If some attention is paid to these matters, the reliability of this indispensable book is sure to be still further enhanced. We must finally thank Dr. Ritschl and the publishers for making available to spectroscopists this beautiful improved edition of Prof. Kayser's famous work.

T. S. S.

Text-Book of Heat. By R. W. Stewart and J. Satterly. Second Edition, revised by C. T. Archer. (University Tutorial Press, Ltd., London), 1939. Pp. viii + 410. Price 7*sh.* 6*d.*

This revised edition of the well-known text-book of Stewart and Satterly shows a marked improvement both in the external appearance and in the contents. The new format and type are much more elegant and pleasing. The additions are also extensive and important, much recent work being described. The treatment is inclined more towards being descriptive and practical, mathematics being restricted so as to exclude the Calculus. The descriptive portions of heat included in the book are more than ample for an Indian Pass Degree, though the theory is well within the attainments of Intermediate students. But the use of such elementary methods throws fresh light on the meaning of the equations developed, *e.g.*, in the sections on Conduction of Heat and Kinetic Theory. Very few important topics are omitted, but some account of Quantum Theory in connection with Radiation should surely be included so as to reflect in some measure the present state of the subject. A short section on the recent work on the cooling produced by the demagnetization of paramagnetic salts may not be out of place. The explanation of superconductivity by the laconic statement that "copper and iron become almost perfect conductors at — 223° C." may also with advantage be replaced by a little more extended treatment. The conditions under which the results of Lees and Chorlton's experiment are expressed by the formula given in the book may be stated more expressly, particularly since this formula is different from the one usual in other books. Fig. 200 illustrating Forbes's method is misleading, since all the thermometers appear to indicate the same temperature. The definition of a molecule as 'the smallest portion of a substance which can exist in a free state and retain the properties of that substance' is surely wrong; it leads to the absurd conclusion that the same properties as those of matter in bulk are also possessed by the molecules. The statement on page 40 that in the example given, "the error introduced by taking L_1 instead of L_0 in the definition of the coefficient of expansion is 1 in 1700" is incorrect since the difference between L_1 and L is here only about 1 in 4000. We have noticed only three misprints: 'deduce' for 'deduct' on page 22; V_{ot} for V_0t on page 63 and Van de Waal's for Van der Waals' on page 293. This speaks rather for the excellence of the book than otherwise. In the same way our remarks above are not to be taken as in the least indicative of any lack of appreciation on our part. On the other hand, we heartily recommend the book for use in all Indian Universities, particularly inviting the attention of Pass Degree candidates to the excellence of the descriptive portion of this text.

T. S. S.

Regionale Geologie der Erde. Herausgegeben von K. Andrée, H. A. Brouwer und W. H. Bucher, Band 1. *Die Alten Kerne.* (*a*) The Indian Peninsula and Ceylon, by G. de P. Cotter; and (*b*) The Middle and West Australia, by E. de C. Clarke. (Akademische Verlagsgesellschaft m.b.H., Leipzig), 1938. Pp. 60.

At the invitation of the Akademische Verlagsgesellschaft, K. Andrée, H. A. Brouwer

and W. H. Bucher have undertaken to edit a "Regional Geology of the Earth" the scope of which is defined in the preface as follows: "The distinguishing feature of this work is the attempt to set forth in as small space as possible the development of the geology of the whole face of the earth, with special emphasis on those tectonic and magmatic events from which may be derived significant laws of geological development, with due regard to such features as accomplished and resulted from these processes, such as metamorphism, localization of ores, erosion and sedimentation. The major facts of stratigraphy are introduced as clues to and records of events, not as objects of study for their own sake". The work is divided into three volumes—Vol. I dealing with the Ancient Coigns; Vol. II with Palæozoic Plateaulands and Folded Belts; and Vol. III with the later Orogenic Belts.

The present number of Vol. I includes 2 parts, one on the Indian Peninsula and Ceylon by G. de P. Cotter, and the other on Middle and West Australia by E. de C. Clarke. In the first part which covers about 65 pages, there are 4 chapters dealing with the evolution of Peninsular India from the Archæan times to the present day, with frequent reference to the results of modern researches; and in Chapter 5 we have a summary of the main conclusions in the study of this geological history. In the second part dealing with Middle and West Australia, E. de C. Clarke follows a similar plan of treatment and gives a review of our present knowledge regarding the geological evolution of this part of the country.

It was an excellent idea on the part of the Akademische Verlagsgesellschaft, to have thought of publishing a 'Regional Geology of the Earth' on the lines they have proposed; and when completed, the publication is bound to be a valuable reference book for geologists all over the world.

L. RAMA RAO.

An Introduction to Botany. By Arthur W. Haupt. (McGraw-Hill Publishing Co., Ltd., London and New York), 1938. Pp. 396. Price 18*sh*.

Teachers of Botany have reasons to feel gratified at the regular stream of new books that have been coming forth on the subject during the last 6 or 7 years. Quite a number of these rank high as really teachable texts; others seem indifferent to the needs of the teacher as well as the taught, and a few are so poor that they need never have been published.

Even a cursory glance shows that Prof. Haupt's book ranks among those of the first category. The subject-matter has been presented in a clear and simple style, and the illustrations—both photographs and drawings —are splendid. The printing is excellent and typographical errors are so rare as to be negligible.

As mentioned in the Preface the book has been designed to serve as an Introductory text to fit a one semester course. For this reason descriptions have been kept brief and simple, although by judicious elimination of minor details the author has succeeded in including a very fair amount of information.

The student is first introduced to the macroscopic characters of the vegetative organs of the flowering plants and then to the microscopic ones followed by a discussion of the physiological processes taking place within them. A study of the flower and fruit comes later and then a very useful chapter on Heredity and Plant Breeding. The second part of the book deals with the various groups of the plant kingdom treated in an evolutionary sequence. Finally there is a chapter on the Plant Life of the Past and another on the Causes of Evolution. In the end there is a very useful index of 14 pages.

The book is satisfactory from every point of view, *viz.*, style, lay-out, accuracy of the illustrations and general get-up. The presentation is well balanced and it ought to be of considerable use to the Intermediate students of our colleges. The only thing that the reviewer would have desired is the addition of a chapter on Applied and Economic Botany. Many of the students will not have occasion to pursue higher studies in Botany and a knowledge of this kind would no doubt have a great cultural value in making them useful and well-informed citizens.

The publishers are also to be congratulated on such a carefully published and well illustrated volume.

P. MAHESHWARI.

The Principles of Electric Power Transmission by Alternating Currents. By H. Waddicor. Fourth Edition. (Chapman & Hall, Ltd., London), 1939. Pp. 458. Price 21/-.

The book would appear to serve the needs of University students of Electrical Engineering in the important subject of power transmission. It is written in clear language

but assumes a knowledge of applied mathematics of fairly high standard. It begins with the exposition of the fundamentals of inductance and capacities of conductors which are so essential to the student as well as the engineer. The chapters dealing with performance of transmission lines give the well-known methods. Considerable importance has been given to losses and thermal phenomena in cables, so little appreciated in this country.

Information about overhead insulators is rather meagre. The general principles of economics should serve as a useful guide to beginners, but experience and local conditions very often render the principles inapplicable and unsafe. The chapters dealing with the protective measures are informative and interesting. G. Y.

Geology of India—A New Edition. By D. N. Wadia, M.A., B.Sc., F.G.S., F.R.G.S., F.R.A.S.B., Geological Survey of India. (Macmillan & Co., Ltd., London), 1939. Price 24*s.* net.

The first edition of Mr. Wadia's *Geology of India* was published in 1916 with the object of "providing a manual, in the form of a modern text-book which summarises all the main facts of the subject, within a moderate compass". The need for such a standard text-book was becoming increasingly realised for several years before 1916, and Mr. Wadia's book was immediately welcomed as meeting this real want; and the fact that during all these years, there hasn't been another text-book of Indian Geology, written in India or outside, shows how admirably well Mr. Wadia's book has been serving the purpose for which it was intended. In view of the fact, however, that the study of Indian Geology has progressed enormously within the last 25 years, it was only natural that the book gradually came to need substantial revision. This has now been done, and we are glad to welcome this revised and enlarged edition. The general plan of treatment is the same as that in previous editions but the subject-matter has been "thoroughly revised and brought up-to-date by incorporating the results of new research". Several new diagrams have been added, and the value of the book is considerably enhanced by the addition of a beautiful and up-to-date Geological Map of India, on the scale of 96 miles to 1 inch.

In the chapters dealing with the Archæan System, the recent additions to our knowledge due to the researches of leading workers like Sir Lewis Fermor, Dr. A. M. Heron, Dr. J. A. Dunn, Dr. M. S. Krishnan and Mr. B. Rama Rao, in different parts of India, have all been briefly incorporated. In writing the chapters on the Gondwana System, Mr. Wadia has had the valuable collaboration of Prof. B. Sahni, to whom we owe practically all our recent knowledge of the fossil floras of the Gondwana System. In the chapter on the Deccan trap, there is a brief reference to the recent palæontological discoveries in the lower inter-trappean beds, and their bearing on the problem of the age of the traps. On this matter, Mr. Wadia summarises the present position thus: "From external evidence, it is quite apparent that the Deccan traps cannot be older than the Danian stage of the upper cretaceous, while from the internal evidence of fossil fishes, palms, and foraminifers, etc., they could not be much younger than the Eocene". It will be remembered that till very recently, the prevailing view in this matter was, in the words of Mr. Wadia in the first edition of his book: "From external evidences, it is quite apparent that the Deccan traps could not have been older than the Cenomanian stage of the upper Cretaceous, or much younger than the Danian stage of the very topmost Cretaceous". The chapter on the Eocene System includes the main results of the recent valuable researches of L. M. Davies and E. S. Pinfold embodied in their Memoir on the 'Eocene Beds of the Punjab Salt Range'. Attention has also been drawn to Mr. E. R. Gee's recent work which has demonstrated that the Saline series of the Salt Range is "clearly of Laki age, and not (as was previously thought) of Cambrian or pre-Cambrian age"—thus bringing them into line with a similar group of beds in the Kohat Dt. of known Laki age. Dealing with the rocks of the Glacial age in India, Mr. Wadia has given a valuable table showing the suggested correlation of Glacial stages, with the upper Siwaliks of north-western India, according to De Terra. The large volume of work that has been done within recent years on the structure of the Himalayas, especially in the western and north-western portions, by Dr. G. E. Pilgrim, Mr. D. N. Wadia, Mr. W. D. West and Mr. J. B. Auden, has been nicely summarised, with special reference to the main tectonic features of the three structure-zones —the Foreland, the Autochthonous Fold Zone and the Nappe Zone—in illustration of

which several digrammatic sections have also been given.

We have no doubt that this book by Mr. Wadia will continue to be popular with an ever-widening circle of students and teachers of Geology in India. Its value will also be very much appreciated by workers abroad—and their number is greatly increasing within recent years—who want to get familiar with the main outlines of the geology of this country.

The general get-up of the book is excellent. L. RAMA RAO.

Psychopathic States. By D. K. Henderson. (Chapman & Hall, Ltd., London), 1939. Pp. 179. Price 8/6 net.

This volume represents the sixth of a series of books based on Thomas W. Salmon Memorial Lectures delivered under the auspices of the New York Academy of Medicine, and comprises three addresses on "Place in Psychiatry", "Clinical Manifestations" and "Social Rehabilitation". The purpose of these lectures is to draw pointed attention to a group of unfortunate individuals, whose condition constitutes one of the fundamental problems of Society, and the author sets out in the three addresses to establish the need for socialization of these problems. The seriousness of these problems in relation to the well-being and progress of mankind does not receive, generally spaking, that consideration which their importance demands, and within the short compass of this interesting book, the author has presented his material and argument in such a skilful and attractive manner, that the reader is convinced about the urgency of medical, legal and public action.

The first discourse deals with a historical review of the place of the psychopathic state in psychiatric practice and literature and emphasises the necessity for intensive study. The topics included in this essay are the contributions of the various schools, the various components producing conduct disorder and constitutional medicine. Although psychiatry has advanced far ahead of other departments of medicine, still the study of psychopathic states remains not very clearly understood and differentiated. Medical science will therefore welcome the efforts of the author to focus pointed attention on the study of the motives underlying the conduct of people in our midst "semi-insane and semi-responsible", who, in every avenue of life, "not only are unable to conform adequately in their personal lives, but may even be responsible for some of the greatest social crimes in history".

The purpose of the subsequent lectures is to discuss such people, recognise them and bring them forward "into the noontide sun of revelation so that we can resolve matters on a more satisfactory and harmonious basis". The clinical manifestations of such men and women form the subject-matter of the second lecture, and the reader is presented with a sumptuous fare of fascinating problems such as "aggression, suicide, murder and assault, alcoholism and drug addiction, epilepsy, sex variants, criminality, cycloid states, schizoid states, talent and creative faculty" all profusely illustrated by typical cases. The instances, of course, form the mournful life-stories coming under the experience of professional psychiatrist, and the lay reader should be careful in holding his mental balance while perusing the morbid history of the decadence of human mind. The best of mankind, including, of course, authors and reviewers, cannot obviously escape from the pressures of the unconscious mind on the one hand, and from the developmental deficiency in the cerebral cortex on the other, each being a contributory cause for conversion of idealism and insanity, one into another: for in both cases men under the influence of ungovernable impulses shatter their minds against a world of hard realities. These facts which excite our sympathy also raise the more fundamental problems of how society can assuage the rigours of the misfortunes of the psychopath.

A wide survey of conduct disorder embracing all the manifestations of impaired mental health must necessarily lead to the formulation of attempts at social rehabilitation which is the subject of the third discourse. Here the author endeavours not only to change the complexion of psychiatry, but attempts "to open its eyes wider so that its obligations not merely to the individual but to the race, which after all, far transcends the individual, can be more adequately and justly performed".

This is a deeply interesting book which presents the matter of one of the most acute problems in an eminently attractive and readable form, and which will, therefore, be welcomed not only by the general practitioners in psychiatry, but also by the cultured public. In these days of "tensions", "appeasement", "aggression", "peace blocs"

and "axis rantings", the rival camps in their hurry to impeach the conduct of each other, have neither the time nor the inclination to test their own sanity, and democrats and dictators and communists, it is our confident hope, will find in this book much that will appeal to their rationality.

The Cause of Cancer. By David Brownlie. (Chapman & Hall, Ltd., London), 1938. Pp. 207. Price 7*sh.* 6*d.*

The cause of cancer is still shrouded in mystery in spite of extensive and intensive investigations. Recent researches have proved conclusively that chronic irritation due to various causes plays an important rôle in its development. Experimental investigations on animals have shown that coal tar and some of its derivatives can induce cancer. Among the proved causes of cancer may be mentioned: (1) Soot; (2) high temperature carbonization coal tar from manufactured towns' gas retorts and by-product recovery coke ovens; (3) other carbonization tars and crude oils, *e.g.*, shale oil; (4) certain varieties of lubricating oils, which give rise to the variety of cancer, known as, mule spinner's cancer.

Long continued irritation of some parts of the body may give rise to cancer, *e.g.*, cancer, following the irritation of a jagged tooth, gall stones, syphilitic ulcers, metal or other body warmers, containing burning charcoal, ('Kangri burn' cancer among certain hill tribes in Kashmir), too much exposure to X-rays. Cancer of the tongue and lips occurs among those smoking clay pipes and cancer of the bladder is known among aniline oil workers. In India, the greater incidence of cancer of the jaw and cheek in the West Coast appears to be definitely associated with the chewing of tobacco and the use of a particular variety of lime with it.

The above definite causes, however, are only responsible for an extremely small proportion of the incidence and mortality due to cancer. So far, nothing is known regarding the cause or causes of cancer, not attributable to the above factors and arising in other parts of the body.

The author presents in this interesting book a theory as to the etiology of cancer, based on rational grounds, which justify further research in the direction indicated. The author's theory is that cancer is possibly due to a large extent to the presence of certain poisonous organic substances in manufactured towns' gas and other combustion gases and in smoked foods. "A large proportion of cancer cases are due to eating contaminated food, resulting from the wide-spread use of contaminated towns' gas for cooking under conditions, as in most designs of gas cookers (ovens), that both the gas to some extent and all the waste combustion products are in direct contact with meat, bread, pies, cakes, biscuits, milk, puddings and other products."

Cancer causing poisons can be conveyed to the body in other ways than by direct contact with food. The dust emanating from tar macadamised roads is a potential cause of cancer. Another possible cause is the wide-spread pollution of the atmosphere by leakage from towns' gas supply. Among other factors of importance for the pollution of the atmosphere must be mentioned, the discharge of the waste combustion products of motor vehicles and presence of carbon monoxide in the waste combustion gases, formed in the burning of any type of fuel, gaseous, liquid or solid.

The theory of the cause of cancer, being due primarily to complex benzene ring hydrocarbons formed by high temperature carbonization, heat decomposition and combustion under certain conditions, should be carefully examined by cancer research workers. If the theory is proved, human misery due to cancer can be placed in the group of preventable diseases.

Mr. David Brownlie is a Chemist and a Chemical Engineer and not a medical man. His contribution is, therefore, limited to an analysis of the possibilities from the standpoint of one, who has had many years of experience in matters relating to combustion and carbonization. He realizes that his theory has not yet been proved.

I commend Mr. David Brownlie's book on *The Cause of Cancer*, especially to cancer research workers. All members of the medical profession and the public will profit by a perusal of this interesting book.

T. S. TIRUMURTI.

Forest Pathology. By John Shaw Boyce. American Forestry Series, First Edition. (McGraw-Hill Publishing Company, Ltd., London and New York), 1938. Pp. 600 + 216 illustrations.

Forest Pathology which deals with the diseases of living forest plants is a comprehensive study, but if it should extend to the timber affections as well, becomes too unwieldy a subject to be compressed into some

600 pages, unless in the hands of an expert like Professor Boyce. Though the book is mainly concerned with the diseases of North American plants, the application of its general principles could advantageously be made in a vast country like, for instance, India with its large stands of virgin forests. It is therefore a valuable addition to all forest libraries in this country and a great help to the research workers in this field.

The classification of diseases is a complicated task but in this book it has been much simplified being based mainly on the susceptible stages and parts of the trees such as "Seedling," "Root," "Foliage" and "Stem disease", etc., and an elaborate bibliography attached to each item makes the work specially valuable. The semi-diagrammatic illustrations and notes published therein, with reference to fungi lessen the difficult task of diagnosis, within the scope of the book.

The few references to foreign diseases, for instance the Spike-disease of Sandal, which is cited as a mere example of a virus disease, could have been a little more elaborated in view of its scientific, apart from local and economic, importance as the most typical and destructive virus disease of a forest tree. It is to be regretted that, no doubt the limitations of space could not also permit the author a broad survey of the source of the most important faunal causal organisms such as for instance Termes, Anobium, Xestobium and Teredo, etc. ("Deterioration of dead timber").

Two appendices deal with "Fungicides" and "A list of common names of plants used with scientific equivalents". The Index is compiled with American thoroughness.

The book is well got up and profusely illustrated. The hope modestly expressed by the author that the volume "will serve both as a text and a reference book" will be more than realised. S. A. K.

Brewing — Science and Practice. By H. Lloyd Hind. Vol. I.—Brewing Materials. (Chapman & Hall, Ltd., London), 1938. Pp. xiv + 505. Price 50*sh.* net.

The attempts made during the nineteenth century to understand the principles underlying the practice of brewing and redeem it from empiricism, yielded very valuable results. During the following years, the science of brewing became a "live" subject and attracted the attention of a large number of scientists with the result that the brewing industry has been, now, placed on a rigidly rational foundation.

There are several books in English which seek to give collected and classified information on one or the other aspects of brewing; the credit for producing a comprehensive treatise, emphasising the scientific principles of brewing, and at the same time proving useful to the practical brewer, goes to Lloyd Hind. The first volume is devoted to a discussion of brewing materials. Four chapters are set apart for a discussion of the structure, classification, physiological characters and composition of barley, the basic raw material of the brewing industry ever since man became acquainted with the virtues of beer. Barley has few rivals, although in countries where rice is abundant, that cereal has come to be looked upon as a substitute for barley. Three chapters are devoted to hops and three others to water. There are other sections devoted to the biochemistry of malt, brewing sugars, all ably presented. The task of bringing together in one volume both the theoretical and practical aspects of brewing, must have entailed considerable difficulties both of planning and presentation. The science of brewing buts into several specialised fields of research and the collection of all relevant matter must have necessarily involved considerable amount of library work. The outcome of all this labour is an eminently readable account of the chemistry and application of the raw materials of brewing.

The book will undoubtedly supply a long-felt want; it seeks to provide the practical man with sufficient scientific knowledge to make him intelligently appreciate the why and the wherefore of his processes. "Insist on maturity while selecting barely", "Select barley of low nitrogen content", etc., are commandments, which the brewer had long practised but whose rationale he will appreciate from a study of the facts properly marshalled and presented in the volume. A qualified chemist will, perhaps, find the scientific treatment rather elementary, but this is inevitable in a volume designed to meet the needs of the practical brewer. He will, however, find sufficient matter, in other parts of the book to interest him.

The book is well got up, and is free from errors. One error which came to the reviewer's notice appears in the description of *papain* (p. 171) where it is mentioned that the enzyme is active in neutral or alkaline solutions. This same error is found in

a few text-books on enzymes. Papain is hardly active in alkaline solutions; its range of activity lies in the region pH 4–6.

The appearance of the second volume, relating to Brewing Processes is eagerly awaited.

Experimental Methods in Gas Reactions. By A. Farkas and H. W. Melville. (Macmillan & Co., Ltd., London), 1939. Pp. xv + 389. Price 30*sh.* net.

The book has been written for the experimentalists by two experienced and distinguished experimentalists who have made many valuable contributions to the subject with which it deals. It has been written, as pointed out by Professor Rideal in his Foreword, 'with the object of providing the experimentalists with information of practical value, together with the relevant data not easily accessible', and its perusal reveals that this object has been achieved with conspicuous success. The authors have taken pains to see that nothing of practical value is left out and that there is sufficient amount of theory to minimise the gap between theory and practice. The inclusion of useful data and abundant references to original literature help to make the book a valuable work of reference on the experimental study of reactions in the gaseous phase.

It begins with a chapter on kinetic theory and chemical kinetics, which, besides summarising the principal formulæ, contains useful data about the dimensions, speed, collision frequencies and dissociation energies of important molecular species. This is followed by a chapter on the control of pressure and temperature, which gives a full account of the various devices employed for the production and measurement of pressure and temperature. Water-pumps, rotary oil pumps, and mercury diffusion pumps are described in detail, and a good deal of useful information concerning glass taps, glass cut-offs, greaseless valves, lubricants, greases, and metal-glass joints is included. Methods for the measurement of pressure and temperature are given in great detail, accompanied by neat illustrations of the apparatus and their arrangement. The next chapter is devoted to the methods of preparation and analysis (micro) of gases. The gases described include para-hydrogen deuterium and ortho-deuterium and the chapter closes with tables of vapour pressures.

An important feature of the book is a chapter on photo-chemical technique. In this chapter, a considerable amount of useful information regarding the sources of radiation, methods of measurement of radiation intensity, and the general arrangement of apparatus for photo-chemical investigations has been condensed in fifty pages. Extinction co-efficient of the more important gases serve as a useful guide to indicate the size and nature of the reaction vessel. A description of the photo-electric quantum counter is also included.

The last and the most important chapter of the book deals with the experimental methods for the investigation of chemical reactions, both thermal and photo-chemical. In this chapter, nothing of importance on the technical side has been omitted. The reaction vessels are described in detail and a full account is given of the methods of following the progress of reaction by measurements of pressure and thermal conductivity. Optical methods, including interferometry, polarimetry, spectroscopy and photometry are also mentioned. Full attention is paid to the measurement of the rate of reaction by flow methods, where the theoretical treatment is complicated by the effects of diffusion and convection, and the application of the method is illustrated by means of typical examples, such as the investigation of atomic reactions. A good deal of space is devoted to photo-chemical and explosive reactions, and to catalysts used in gaseous reaction.

A book of this type was badly needed and the authors must be thanked for having satisfied a long-felt need. It is hardly possible to overestimate its value as a book of reference for those engaged in the experimental investigations of gaseous reactions, and as a useful guide for those who wish to enter this field of research. It should find a place on the library shelves of every chemical laboratory where any kind of advanced work is being carried out.

The book is well produced. The only misprint noticed by the reviewer occurs on page 207, line 14, where there should be 'of' in place of 'and' after the word 'intensities'.

M. Qureshi.

A World Survey of Soil Erosion.*

THE Rape of the Earth was the title chosen by the authors, but was at first refused by the publishers as being too sensational and liable to disappoint a large public avid for thrills but not particularly interested in a work of soil erosion. When I met the authors at home last summer the match between themselves and the publishers was on, but apparently has since been settled in a victory for the authors, as their title has been accepted and used, though possibly it is the publishers who have introduced the less sensational sub-title of "A World Survey of Soil Erosion".

Both the authors are recognised authorities in their own particular spheres, Jacks as a soil chemist and Whyte as a grass-land ecologist, but it is a sign of the times that both should emphasise the social repercussions rather than the technical difficulties of introducing effective erosion control. We know roughly what are the agricultural, pastoral, forest and engineering principles which ought to be adopted to stop the present appalling waste of valuable top-soil but we cannot, or dare not, apply them forthwith on a scale commensurate with the gravity of the situation. "The problem of soil conservation is not solved merely by discovering the simple practices that will minimise erosion; when the right practices have been discovered, or, more correctly, when the need for adopting the practices has been recognised, the great task is to procure their general application."

In this connection it is interesting to read how in almost every country it is the method of land tenure which is proving the chief stumbling block to the introduction of organised control. No year-to-year occupier will spend labour or money on improvements. Tenant farmers all over the world, whether on a crop share or a cash basis, are forced through the very nature of their agreement with their landlord, to extract whatever they can from the soil, regardless of its ultimate productivity. The crop share is usually for edible crops, therefore the landlord does not encourage the tenant to grow the clovers and pasture plants which contribute something of good back into the soil. Short leases prevent the introduction of soil-improving crops or of a rotation of crops which will conserve the soil fertility. The common holding of waste land is in India and many other countries the root cause of deterioration because common land is "nobody's child" and is inevitably neglected.

The book rightly emphasises the ultimate dependence of all industrial and scientific development upon the welfare of the cultivator and the productivity of the soil. This is, or should be, transparently clear in India, which is essentially a land of villages. In the present enthusiasm for industrial development in India the fact is often overlooked that the purchasing power of the country in absorbing manufactured goods depends directly and almost solely upon the prosperity or poverty of the millions of villagers who either own and till their own land or rent that of a neighbouring owner. The authors blame the introduced methods of cultivation for the serious erosion in many of the "younger" countries, but in India the trouble is due to the indigenous agriculture, whose uneconomic practices combine with over-population to destroy the valuable top-soil, even on comparatively level lands.

According to General Smuts, quoted in this book, "erosion is the biggest problem confronting the country, bigger than any politics". If this can be said of South Africa where politics are a dominant and violently disruptive force, it can be equally safely said of India. Does it matter much to the Punjab whether it has a Unionist or a Congress Government if its main army recruiting grounds, namely the Jhelum Salt Range, the Hoshiarpur and Ambala Siwaliks, and the Rawalpindi foothills, are being reduced to a desert which will sustain neither man nor beast? Out of the many striking photographs showing phases of erosion in such far countries as Texas, Australia, Peru, the Lower Don of Russia, Nyasaland, Natal and Basutoland, most could be replaced by photographs of Indian conditions without either the authors or the landowners realising the deception.

As a study of contemporary scientific developments this book is invaluable and should be in the hands of everyone who has to do with the land and its manifold agricultural uses. The later and more spectacular phases

* *The Rape of the Earth*, by G. V. Jacks and R. O. Whyte. (Published by Faber and Faber, London), 1939. Pp. 312. Price 21*sh*.

of soil erosion have been subordinated in this study, and prime emphasis laid upon the *gradual loss of porosity* which is the most serious early symptom. This is accompanied by a loss of cohesion, and the insidious action of sheet-washing such as occurs on exposed fallow does its worst damage by destroying the *crumb structure*, that illusive but essential characteristic which is now coming to be recognised as of far more importance to soil fertility than any other single chemical or physical character.

In this connection the book gathers up the threads of contemporary research on the erodibility of both cultivated and uncultivated soils. It shows that this feature is only a relative term, because of the radical alterations which take place in the crumb structure of forest and grass-land soils whenever these are brought under cultivation. Each type of plant cover evolves a top-soil which is suitable to it; thus the coniferous forest builds up an almost structureless mass of light friable humus which is a permanent feature of the forest floor, but which disappears rapidly when the forest is felled and replaced by fields. The problem of the overfelling of private forests again brings forth a comparison of the United States with India, for in the Chota Nagpur plateau and the Hoshiarpur Siwaliks there is a crying need that the destructive tendencies of private ownership should be influenced by government control and advice. In South Africa the government is going in for the purchase of large areas of mountain land in the Union, the object being to check further abuses from over-grazing and the ploughing of steep slopes. Much of South Africa's most important catchment lies inside Basutoland, which is not under the Union Government, but here a 10-year programme of erosion control is being financed from the Colonial Development Fund by the Colonial Office, largely in order to help the Union.

Turning now to the authors' remarks on India, we read: "Over much of India the people have accepted a slowly deteriorating environment as part of the scheme of things; the vast majority is probably unaware that erosion is occurring". This is indeed an indictment which cannot be denied, but which ought to be taken up as a challenge. It is only by redoubling our efforts in educating the cultivator that we can alter this. The authors emphasise that the stabilisation of eroding lands cannot be effected by purely dictatorial legislation. The greatest recent advance in erosion control is the establishment by law of "conservation districts" in the U.S.A., where a majority vote of the farmers in an administrative unit can now form a district committee. This committee has very wide powers to coerce those who refuse to come into line with the experts' recommendations as laid down in their working scheme, which is more or less the forester's "working plan" of our Indian practice, but widened to make erosion control recommendations for every type of land in the vicinity. Starting in 1933 with demonstration projects scattered over most of the states, the Federal Government paved the way for this by educating the farmers in project areas to look after their own land, and the logical outcome is this delegation of authority to a local democratic body with powers to follow and enforce the experts' advice.

The authors frequently mention Java and the Dutch East Indies as having been saved from the erosion danger by the timely action of the Dutch Government, but from information gleaned during a visit last summer to their admirable Colonial Institute in Amsterdam, I gathered that the Dutch foresters and erosion experts were far from satisfied themselves over the rate of progress in counter-erosion work, particularly in the poorer soils of the more remote uplands. The fact remains, however, that the Dutch colonial organisation is fully alive to the danger, though it has not been mastered yet, except in the most intensively cultivated plantations which are under skilled European management.

A phase of soil conservation work which has not been sufficiently discussed in India, but to which the authors devote much space, is that of tree shelterbelts. The results of early tree belts planted in Russia are so satisfactory that the Soviet Government adopted a programme for establishing 865,000 acres of shelterbelts in their second Five-Year Plan. This compares in magnitude with the U.S.A. maximum of 1¼ million acres in 10 years for the Great Plains Shelterbelt project which is now going forward. In the Californian fruit districts shelterbelts are a *sine qua non* of good farming, and for orchard land it is considered worth while to have 10 per cent. of the area 15 dollars (40 rupees) per orchard acre under wind-break trees, and to spend up to

upon wind-break maintenance. Considering the recent large developments in Malta orange planting in the irrigated Punjab plains, it seems strange that this essential point in the Californian fruit-growing technique should have been neglected.

Amongst the many ways of checking erosion and reducing run-off from sloping lands, emphasis is rightly placed on *contour ridging*. In fact the authors harp so much on the need for terracing, trenching, and ridging at right angles to the slope of the land that they have coined a new phrase "contour farming" to cover the many minor variations of this standard principle in run-off control.

The book attempts to assess the wider implications of soil conservation activities throughout the world. In spite of the publicity which has focussed attention on this work in the U.S.A., the authors have decided that the African continent must now take the foreground for erosion "news value". In the U.S.A. a conservation economy is being developed on a vast scale and in an orderly manner, whereas in Africa the need for such work is even more urgent but the issue is much more complicated owing to the conflicting aims and interests of the several governments, the varying standards and needs of black and white populations, sometimes mixed, sometimes segregated, and the technical difficulties connected with the ecology of arid grass-lands and dry savannah forest. Due place is also given to the great effort now being made by Russia, for the Russian plan does not stop short with saving soil and stopping floods, but aims at a Utopia by harnessing all the rivers east and west of the Urals into a gigantic scheme for the conquest of the semi-arid steppes.

R. MACLAGAN GORRIE.

Electricity in Chemistry*

ALMOST the first application of electricity to chemistry was the experiment of Nicholson and Carlisle in which water was decomposed into its elements by a current from the voltaic pile, which had just then been discovered. This was in 1800. In the immediately following decades, the new tool of electricity held the fascination of the leading chemists. In particular, the classical work of Faraday and the laws enunciated by him have remained to this time fundamental in all considerations dealing with the relationships between electricity and chemistry.

Studies on these relationships increased rapidly, and when Arrhenius promulgated his hypothesis of ionisation equilibria in solutions, a definite big impetus was given to the whole subject. The thermodynamic study of energy in chemical systems had just then been initiated and was in the full vigour of its youth. It was soon realised that the electrical energy connected with galvanic cells was of a reversible type and that rigorous methods of thermodynamics could be applied to many of the chemical changes involved in the galvanic cells. The relationships between chemical and electrical energies, particularly in liquid systems, have since been developed by systematic work into a subject in itself, under the caption of "Electro-chemistry". This term 'electro-chemistry' can at the present day however comprehend a much wider range of topics, for, much of the recent investigations on the electrical nature of matter and of the chemical reactions between them, the investigations mostly carried out by physicists on the electrical conductivity in solids and gases, and several other aspects of molecular physics could all be included under this head. Indeed it will be difficult to draw any sharp line between "electro-chemistry" and other branches of physics and chemistry.

Still the old and somewhat arbitrarily defined 'electro-chemistry', which includes mostly studies of chemical reactions brought about by electrical energy and of chemical reactions giving rise to electrical energy, is itself a wide and steadily growing subject. Considerable progress has been made in this field after Debye and Huckel indicated how the then troublesome deviations of strong electrolytes from ideal behaviour in solutions, could be accounted for quantitatively by taking into consideration the interionic attractions and repulsions. As is well known the basic idea in this theory is that each ion is surrounded on the average by an

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The Principles of Electrochemistry. By Duncan A. MacInnes. (Reinhold Publishing Corporation, New Nork, Chapman & Hall, Ltd., London), 1939. Pp. 478 with 148 illustrations. Price $ 6·00.

oppositely charged "ionic atmosphere" distributed with radial symmetry around the ion as centre. This concept besides its success in thermodynamics and potentiometry, has won laurels also in the field of conductometry. The ionic atmosphere gives rise to a retarding effect on the mobility of the ion, and this along with another effect pointed out by Onsager, as due to a finite time of relaxation between the ion and its atmosphere, is able to successfully account for the observed equivalent conductance of solutions of strong electrolytes at least over the range of low and moderate concentrations. Other consequences of the Debye and Huckel theory such as the Wien effect at high field strengths, and the dispersion effect at high frequencies have been predicted and verified. All these new ideas and theories have brought in their wake, considerable improvements in the technique of electrical measurement on solutions.

As regards practical applications, the principles of electro-chemistry have been utilised from the earliest days in the arts of electro-plating, electro-metallurgy, etc., while indirectly they have been of even greater use in the control of industrial processes, through conductivity, pH and E.M.F. determinations. On the fundamental side, electro-chemistry has provided some powerful tools in investigations relating to chemical reactions involving strong electrolytes, the nature of molecular complexes, hydrolysis and solubility of substances from conductometric measurements, studies on the course of reactions from potentiometric and conductometric titrations, the analysis of proteins from electrophoretic studies as developed by A. Tiselius, etc.

Among the leading contributors to this renaissance in electro-chemistry, Dr. MacInnes is a prominent figure. The work of MacInnes and his associates is characterised throughout by systematic attempts to improve the accuracy of experimental data, and they have achieved many significant successes in verifying the predictions of the interionic attraction theory with respect to activity coefficients, conductivity, etc. The book itself which Dr. MacInnes is now presenting to the scientific world can rightly be described as another and fundamental contribution to the science of electro-chemistry. It breathes of precision throughout: the experimental portions described deal with the modern refinements of technique while the theories are clearly and succinctly recounted by leading up from first principles wherever possible. Ample references to the original literature, most of them of recent dates, have been provided to help the reader further on. In many ways a marked and very welcome feature of the book, is the careful, painstaking and critical evaluation of the available experimental data, and of the derived physical constants. The result is, that for the field covered the book takes a front rank with other critical compilations of data on physical constants. There is, besides, a logical development of ideas, the scope of the book being extended in the last five chapters to the use of conductance measurements in various physico-chemical investigations, the effect of structure and substitution on the ionisation constants of organic acids and bases, the dielectric constants of liquids and the dipole moments of molecules, electrokinetic phenomena, passivity and overvoltage.

There is but little to offer by way of helpful criticism, as it is patent that the book has been brought out with much painstaking care and with clearly defined objectives. However, a few illustrative problems either as an appendix at the end of the book, or at the end of the relevant chapters would have added to the usefulness of this book. As a work of reference to all, it is almost a necessity.

M. A. G. RAU.

INDUSTRIAL SECTION

Semi-Automatic Cell Testing Device for Dry Cells

By L. C. Verman and G. D. Joglekar

(*Industrial Research Bureau, New Delhi*)

THE heavy intermittent discharge test for dry cells of the DU2 type (1¼" diameter × $2\frac{3}{16}$" height), as laid down in British Standards Specification No. 397 of 1933, requires that each cell should be discharged through an external resistance of 5 ohms for three hours per week, with not more than thirty minutes continuous discharge per day. The discharge is to be continued until the potential difference between the terminals, measured at the end of a day's run with the test current flowing and by means of a high resistance voltmeter, has fallen to 0·75 volt per cell, when it shall be deemed to have completed its life. This testing procedure requires that a considerable period of time elapses before the electrical characteristics of the cells can be determined. During the course of the research work which has been in progress at the Government Test House in connection with problems of dry cell manufacture, it was felt that progress could be accelerated if the results of a given set of experiments were quickly made available, so that they could be used to guide further experiments. It was therefore necessary to reduce the testing period without materially changing the testing procedure or appreciably affecting the output results.

The acceleration of the testing procedure was effected by discharging the cells twice a day for half an hour each time instead of once a day as required by the B.S. Specification. In order to conduct both the discharges during the working period of the day, the intervals between successive discharges had to be fixed at 6 and 18 hours. This, however, was far from ideal, for the recuperation period of the cells was thus cut down from 24 hours to 6 hours for alternate discharges. An equal division of the 24-hour period into two 12-hour periods would have been much more desirable. This necessitated an automatic device for effecting and controlling the discharges during hours when the laboratories are normally closed. Such a device was designed and has been in operation for some time. It is briefly described in this paper in the hope that it may prove useful to other workers in this field.

Description

The device comprises a wall clock controlling a set of relays which operate a solenoid fitted with a plunger connected through a mechanical tilting device to two banks of sixty mercury tube switches, the banks being disposed at right angles to each other on a triangular corner-table. Each of these switches is connected in an individual dry cell circuit. Figs. 1 and 2 show photographs of the complete device, Fig. 3 gives the circuit diagram of the test circuits, and Fig. 4 shows the circuit diagram of the control circuit.

In Fig. 1 is shown the controlling clock,

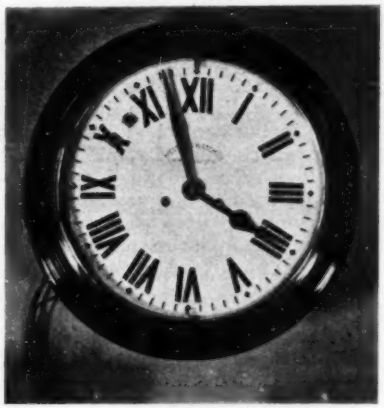


Fig. 1

on the dial of which four insulated platinum contacts are mounted. Two of these contacts make contact with the tip of the hour hand and the other two with the tip of the minute hand. The hour hand contacts are mounted at 10:00 o'clock and 10:30 o'clock positions, while the minute hand contacts are at 12:00 o'clock and 6:00 o'clock positions. Thus at 10:00 o'clock an electrical circuit is closed through the hour hand and the minute hand, while at 10: 30 o'clock another circuit is closed through the same channel. Furthermore, at no other time of the day can either of the circuits possibly close. Thus at 10: 00 o'clock twice a day,

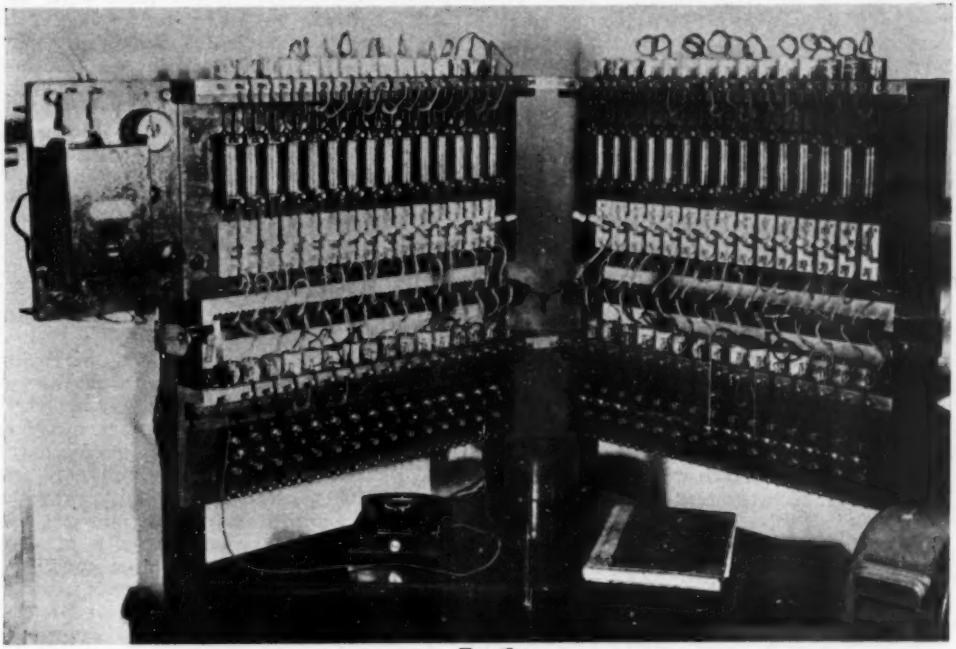


FIG. 2

the closing of the first circuit turns on the cells under test, and at 10: 30 o'clock the cells circuits are opened. In order, however, to take voltage readings from day to day, the automatic device is allowed to act only once a day in the evening, while in the morning, the device is cut out and manual discharges are carried out for which duplicate switches are provided.

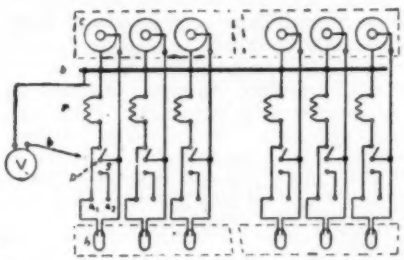


FIG. 3

Circuit Diagram of the Test Circuit

c–Dry cells; *b*–Busbar; *r*–5 ohm fixed resistances; *s*–S.P.D.T. knife switches; *p*–Terminals for voltage measurements; A_1 A_2–Ammeter terminals; *h*–Mercury tube switches; *i*–Wandering voltmeter lead; *V*–High resistance voltmeter.

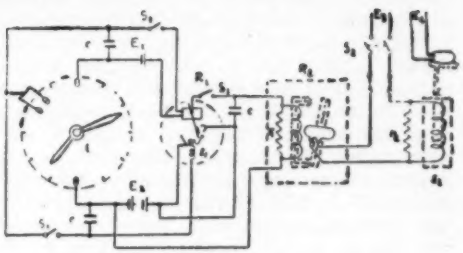


FIG. 4

Circuit Diagram of the Control Circuit

C–Clock; R_1–Sensitive relay; R_2–Power relay; S_1–S.P.S.T. switches; S_2–D.P.S.T. switch; E_1–1·5 volts D.C.; E_2–6 volts D.C.; E_3–220 volts D.C.; E_4–1·5 volts test cell voltage; r_1–Discharge resistance; r_2–Discharge resistance; *c*–1 μf Condensers; s_1–Sensitive relay solenoid; s_2–Tilting solenoid.

The control circuit operated by the clock shown in Fig. 4 comprises a sensitive relay R_1, power relay R_2, and the tilting solenoid s_2.

The closing of the sensitive relay circuit at 10:00 o'clock through the clock contacts operates the power relay, which energises the solenoid and tilts the two banks of mercury switches shown in Fig. 2. The sensitive relay contacts are held closed, because one of them is a permanent magnet, while the other one has an iron rider. At 10:30 o'clock, when the second circuit is closed by the clock contacts, a solenoid marked s_1 (Fig. 4) is energised and draws the sensitive relay contacts apart and thus de-energises the tilting solenoid. The two banks of mercury switches are then tilted back to the open position by the two springs provided.

The sensitive relay and the power relay are Weston relays, model 705 (solenoid reset type) and model 630 respectively. The solenoid s_2 is wound on a brass tube of ⅞" inside diameter by 2½" long with 19,000 turns of No. 30 S.W.G. double silk-covered copper wire, each layer of the winding being treated with a thick solution of shellac during the course of winding. The solenoid is enclosed in an iron body leaving an opening 3" in diameter at the top. On each bank of the tilting device thirty mercury switches are mounted, adjustment being provided for the tilting angle. Two strong springs hold the switches normally in the open position against which the solenoid pulls.

The details of the cell testing circuits are shown in Fig. 3. A double-throw single-pole knife switch is provided in each circuit, one side of which is paralleled to the mercury switch, while the other side is so connected that the discharge current may be read by connecting an ammeter to the terminals A_1, A_2. Short leads are soldered on to the terminals of the cells under test which are placed in cell receptacles. One of the leads of each cell is connected to a common bus-bar, while the other is connected to an independent terminal belonging to its own individual circuit. For manual testing, switches S_1 and S_2 (Fig. 4) are turned off and knife switches s (Fig. 3) are made use of, the voltage readings being taken between the common bus-bar terminal and the terminal marked p (Fig. 3) of the individual circuits.

In order to ascertain whether the device has functioned properly during the night, a strip of blotting paper is attached to the rack carrying the mercury switches and a pool of ink is placed under it just out of contact. When the switch banks tilt, the paper dips in the ink, and the height to which the ink rises indicates approximately the time duration for which the mercury switches were turned on during the night.

Testing of Cells

It is known that the output characteristics of cells are affected by the temperature and the humidity of the surrounding atmosphere. With a view to avoiding the effects of variation of atmospheric conditions, the testing unit is placed in an air-conditioned room, the temperature of which is maintained at 80° F. and the relative humidity at 70 per cent.

The dry cells under test are now being discharged at 10 o'clock twice a day except on Saturdays and Sundays. On Saturdays the cells are discharged only once a day in the morning and on Sundays no discharge takes place. Thus eleven discharges per week are obtained instead of six as provided by the specification mentioned above.

The watt-hour output capacity of cells obtained under double discharge conditions by means of the automatic device is naturally less than that obtained under the B.S. Specification conditions of testing, due to the smaller recuperation period permitted by the former. With a view to determining this loss in capacity a number of cells of four reputable makes were tested in parallel by the two procedures.

The cells were subjected to internal resistance and polarisation tests before putting them on life test. The polarisation tests, though not recommended by the B.S. Specification for this type of cell, was undertaken with a view to obtaining a complete record of the performance of the cells. With the automatic device, voltage readings were taken only once a day in the morning, the average values of the discharge voltages for the night discharges being taken as the average of the two successive morning discharges. The end point of the life test, if occurring during the night discharge, was similarly determined.

The watt-hour output was calculated according to the method given in the B.S. Specification. The power used during the polarisation test was added to the above figure to obtain the total watt-hour output of the cells. The watt-hour output obtained by these two methods of testing, and also the other characteristics, are given in Table I.

TABLE I

Comparative Output Figures obtained by the two methods of testing

Test No.	Laboratory designation of the make of cells	No. of cells tested	Testing method	No. of discharges per week	No. of days required to complete the test	Average characteristics				Increase in W.H. capacity obtained with the B.S. Specification method %
						Initial open circuit voltage	Internal resistance ohms	Polarisation %	Output W.H.	
1	A	3	B.S.S.	6	34	1·56	0·205	17·15	4·13	22·9
2	A	3	Automatic	11	16	1·56	0·215	17·15	3·36	
3	B	3	B.S.S.	6	25	1·56	0·225	21·50	2·57	16·3
4	B	3	Automatic	11	15	1·56	0·250	21·05	2·21	
5	C	4	B.S.S.	6	26	1·56	0·200	21·40	2·90	17·4
6	C	6	Automatic	11	16	1·56	0·215	21·85	2·47	
7	D	6	B.S.S.	6	31	1·56	0·230	17·90	3·25	20·4
8	D	6	Automatic	11	12	1·56	0·230	17·90	2·70	

Average = 19·3

In the last column of this table is given the percentage by which the output obtained by the double-discharge method, using the automatic device, has to be increased in order to calculate the output obtainable if the B.S Specification method had been used. This correction varies between 16 and 23 per cent., giving an average of 19·3 per cent. In practice, therefore, the output of experimental cells obtained by double-discharge method, using the automatic device, requires to be increased by this factor in order to estimate the probable value which might have been obtained by the B.S. Specification method. The probable error of this estimation will be less than 3 per cent., which is very small compared with the normal variations that occur from cell to cell. Table I also shows the saving in time effected by the use of the double-discharge method, which on the average amounts to about 50 per cent. This saving in time, besides making the results of experiments available in a shorter period, virtually doubles the capacity of the testing equipment, thereby enabling twice as many cells to be tested in a given period of time.

The device as it stands has been designed to test dry cells under certain particular conditions. It may, however, be modified at will to give any desired cycle of switching operations involving different timing for on and off intervals.

Indian Science Congress, 1940

THE Twenty-seventh Annual Meeting of the Indian Science Congress will be held in Madras from January 2nd to 8th, 1940. His Excellency John Francis Ashley, Lord Erskine, G.C.I.E., Governor of Madras, has consented to be the Patron of the Meeting. Professor B. Sahni, M.A., SC.D., F.N.I., F.R.S., Professor of Botony, University of Lucknow, will be President.

Intending members are requested to send their subscriptions to the Congress, to the Treasurer, Indian Science Congress Association, 92, Upper Circular Road, Calcutta.

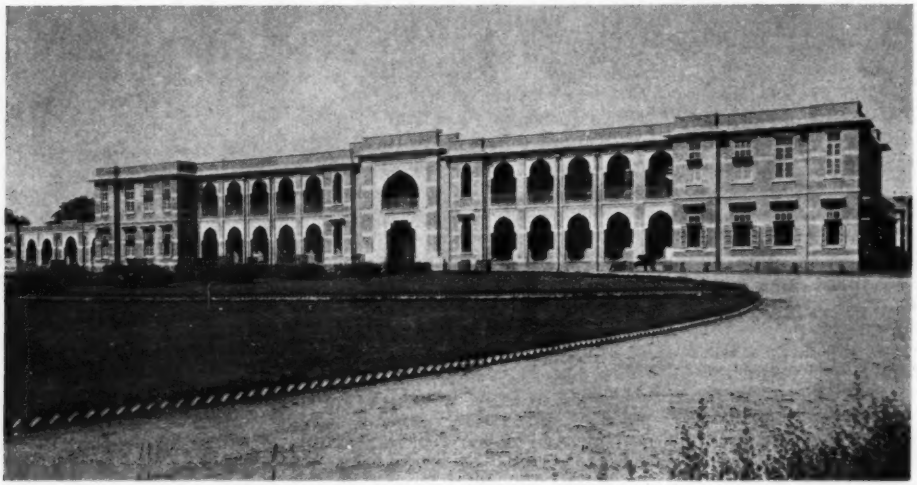
Papers intended for being read at the session should be forwarded together with three copies of an abstract *so as to reach the General Secretary, mentioning the Section, before which the paper is intended to be read, not later than September 15th,* 1939. Abstracts should be typewritten and must not exceed 200 words. They should not include formulæ or diagrams.

No abstracts will be printed unless accompanied by the full paper at the time of submission.

Rao Bahadur A. Lakshmanaswami Mudaliyar, B.A., M.D., F.C.O.G., Principal, Madras Medical College, Madras, and Sri. R. Gopala Aiyar, M.A., L.T., M.SC., Director, University Zoology Research Laboratory, Madras, are the Local Secretaries of the Session.

Shree Sayaji Jubilee Science Institute

WITH the increasing expansion of the activities of the Science Department of the State College, the Government of His Late Highness The Maharaja Gaekwad of Baroda, felt a pressing need to accommodate the science departments of the College in a separate building. At the same time, the Government felt that it was time that a definite step was taken for the Industrial Development in the State, not only to strengthen the existing industries but also to start new ones. Both these objects, it was felt, could be achieved by locating the various science departments of the College in a separate building with an annexe for the Applied Chemistry Laboratories.



Shree Sayaji Jubilee Science Institute

To commemorate the Diamond Jubilee of Sixty Years' Reign of His Late Highness, Sir Sayajirao Gaekwad, Maharaja of Baroda, several industrialists and philanthropists came forward to make contributions towards the building of the proposed Institute, which is now named "The Shree Sayaji Jubilee Science Institute" as a monument to the memory of His Late Highness, and in deep appreciation of the forward policy of His Highness' Government to help industries, agriculture, public health, etc. The needs of the several departments of the State were ascertained by the Government and proper provision was ordered to be made for locating the several laboratories in the technological wing of the Science Institute. The Sayaji Jubilee Science Institute was formally opened by His Excellency the Viceroy, Lord Willingdon, in January 1936. In this Institute full provision is made not only for undergraduate teaching but also for postgraduate research in each of the science departments, *viz.*, chemistry, physics, botany and zoology. In the Technological Research wing, research laboratories for the investigation of industrial problems, problems of agriculture specially those relating to soil, water and crops, and for the examination of food-stuffs are housed. In it are also located the laboratories of the Agricultural Chemist to the Government, of the Industrial Chemist to the Government and of the Public Health Analyst. Provision has also been made for accommodating the Excise Laboratories of the Government. All these laboratories have a common Library. Industrial research is now being carried out at the Technological Institute in collaboration with the Kalabhavan Technical Institute. The Research chemists attached to the Baroda College Chemistry Department, the Technological Wing of the Institute, the Chemistry Department of the Kalabhavan and Alembic Chemical Works, Ltd., are working in close consultation and collaboration. The planning of the scientific activities of the State has tended to minimise expense and yet secure maximum benefit to the Government and the public.

The Industrial Research Section is carrying out the analysis of a variety of products such as type-metal, ink, starch, soap, waters, different types of ores, industrial raw materials, textile auxiliaries, etc., both for the Government Departments and the Industries in the State. It has evolved out a standard composition for the type-metal, which is utilised for the manufacture of the types at the Baroda State Press Foundry at almost half the market price. It helps the textile industry by handling its problems in sizing and finishing of cloth,

analysing raw materials, auxiliaries, boiler feed waters and rendering suitable advice. It also advises the Public Health Department on problems connected with water supply and food materials. It has investigated the conditions of manufacture of "lime washes" from China clay and has rendered immense help to small manufacturers by giving advice and guidance whenever these were sought. The research section is at present engaged in studying (i) the polymerisation of Indian vegetable oils with a view to their utilization in the manufacture of patent leather, book binding leather, etc., and also (ii) the sulphonation of the same oils with a view to their utilisation as textile auxiliaries as wetting out, emulsifying and cleansing agents in textile industry. These investigations have been allotted to the Institute by the Industrial Research Bureau, New Delhi. The possibilities of manufacture of ultramarine, water-glass and the whitening of China clay of Ransipur Mines, are now under investigation.

The Agricultural Chemists' Laboratory was a long-felt want in the State. His Late Highness, as far back as 1912, expressed his desire that the chemical analysis of the soils of the State should be undertaken by the Agricultural Department. With the establishment of the Sayaji Jubilee Science Institute, this hope was realised and the Agriculture Department now possesses a well-equipped chemical laboratory.

Among the problems that are being investigated in this section, mention may be made of the following:—(1) Effect of small doses of potassium nitrate on the growth and quality of tobacco. (2) Studies in Electroculture: Effect on soils and on composition of the plants. (3) Growth of different varieties of cotton on typical State soils, and (4) Composition and nutritive value of *Trichosanthus diocea*.

The Public Health Laboratories, which were equipped in January last, have started work on the Grading of Ghee on the same lines as those carried out under the Agricultural Marketing Advisor to the Government of India. These laboratories are now equipped for carrying out the analysis of food materials such as milk, tea, coffee, flours, etc., with a view to detect adulteration. The laboratories are so designed that if and when the Food and Drugs Act comes into operation, space will be available for additional equipment to cope with all the work in that direction.

It is proposed to house the Excise Laboratories in the same building. These laboratories will undertake the analysis of spirituous preparations with a view to determine the excise duties to be levied on such preparations. The laboratories will be adequately equipped to meet the exacting requirements of the British Government and to enable spirituous medicinal preparations manufactured in the State to pass through the customs on the strength of the analytical reports of the Science Institute. The Sayaji Jubilee Science Institute thus embodies a unification of scientific efforts in research, both pure and applied. It is needless to state that the Government of Baroda deserve warm congratulations from the public for such a sound forward policy.

ASTRONOMICAL NOTES

Planets during August 1939.—Mercury will be in inferior conjunction with the Sun on August 10 and will afterwards become a morning star. Venus continues to be close to the Sun and is not in a favourable position for observation during the month. Mars which is in opposition to the Sun on July 23, will be a conspicuous object in the eastern sky, immediately after sunset; it is however getting fainter, its stellar magnitude decreasing to −1·8 at the end of the month. On August 24, the planet will be at one of the stationary points of its geocentric orbit.

Both Jupiter and Saturn can be conveniently observed in the latter part of the night. The latter will be stationary on August 15 and will be seen on the meridian about an hour before sunrise. Uranus continues to move slowly eastwards in the constellation Aries until August 28, when it becomes stationary. On August 9, the planet will be in close conjunction with the moon.

Comets.—Pons-Winnecke Comet has, as predicted, become brighter, an observation of June 12 showing its magnitude to be 8·5. Information has been received of the discovery of a new object by Jackson at Johannesburgh, which, later on was found identical with comet 1925 II. Schwassmann Wachmann (*U.A.I. Circ.*, 777). At the time of discovery it was a faint object of the 13th magnitude, but it is receding from the earth and becoming fainter.

Perseid Meteors.—The Perseid showers, one of the principal meteoric showers, will occur on August 10–12; the position of the radiant point is R.A. $3^h\ 0^m$; Declination 57° N. in the constellation Perseus.

A Supernova.—In a photograph of the elliptical nebula N.G.C. 4621, taken at Mt. Palomar, Zwicky has found a new object of magnitude 15 (*U.A.I. Circ.*, 774). Spectrographic observations at Mt. Wilson have shown that the object is a supernova about three weeks past maximum. The nebula is a member of the Virgo cluster of galaxies.

T. P. B.

Development of Electrical Industry in India*

ELECTRICITY, in recent years, has become the basis of national economy in industrial countries. A comparison between the indices of electricity production and earning capacity of the people indicate the great rôle that is played by power industry in the economic prosperity of a country.

Electrical supply industry in India has progressed slowly during the past. Recently, however, attempts are being made in many Provinces and States to rationalise the supply industry and centralise, as far as possible, power generation. There is no co-ordination established, so far, between various development authorities. The technical and commercial experience of other countries show that there is a vital need for such co-operation if the country is to exploit to the full, its natural advantages. Electrical manufacturing industry in this country is also of recent origin and is making slow progress. The only manufacturing activities worth mentioning are those of the Indian Cable Co., Jamshedpur; the lamp factories at Bombay, Calcutta, Agra and Bangalore; the transformer winding section of the Government of Mysore; the porcelain insulators (up to 11 K.V.) manufactured at Bangalore, Bengal, etc.; small workshops manufacturing A.C. or D.C. fans, heaters, torchlight casings, dry cells, accumulators, etc., radio repair shops which have recently sprung up in big cities like Calcutta and Bombay, and the Government telegraph workshop at Calcutta. The Indian Electrical Market is mostly in the hands of foreign manufacturers.

Technical research, on which electrical manufacturing industry has to depend for its economic existence in the international field, forms one of the main considerations of the industry to-day which is spending millions of pounds in research. This progress is so rapid that the rate of obsolescence to-day has surpassed depreciation of both the manufacturing equipment as well as manufactured goods, so that the industry is still in fluid condition and no manufacturer can hope to survive unless he has adequate means to keep himself in a line with this progress.

Based on these and other considerations the following tentative plan for the creation of a "Central Electricity Development Board", representing the Central and Provincial Governments and other electrical interests in the country, has been put forward.

The function of the Board should be firstly to co-ordinate, develop, guide and integrate, to the extent possible, the supply industry in the country; secondly to stimulate and guide the proper formation and co-ordinate the policy and efforts of the manufacturing industries to be started. With these aims in view the Board should be empowered.

1. To organise at the centre (*a*) technical and research; (*b*) commercial and statistical, services under its control.
2. To devise legislation for the formation of Central Financial Trust to work in co-operaton with the Board.
3. To develop suitable trade relations with foreign firms with a view to start manufacturing industry in India with their co-operation.
4. To organise Indian technical education and services in co-operation with Indian educational centres and manufacturing firms in this country and abroad.
5. To devise legislation, in proper course of time, relating to such matters as general supervision, protective tariffs, standard specifications, electricity rates, relations with consumers, electrical prices, etc., which are essential for the healthy development of the industry.

It may be suggested that in general the main monetary burden of a supply scheme should be shouldered, as it is done to-day, by the Government of the Province in which the scheme is located whereas the major portion of the capital required for financing a manufacturing concern should come from private sources. The Central Trust would thus be relieved of a major responsibility, and can depend upon the initiative of Provincial Governments and private industrialists to make a success of an undertaking. The sharing of capitalization by foreign firms whose aid is essential, at least in technical matters will have tc be considered in this connection.

The provincial electrical engineering departments should maintain the necessary services to work in co-ordination with the Central Organization. Provincial surveys relating to power and other resources, potentialities of load development, connections with local industrialists, commercial propaganda, and such other matters, should be left to the Provincial Departments.

Potentialities of electricity in a country cannot be assessed merely from the immediate profit-earning capacity of the electrical industry. In a general programme of industrial regeneration of a nation the part played by power and implements of cheap production claim equal attention. Judged from this point there is a wide field for electricity to grow in this country. At this stage, therefore, what is necessary is a guiding hand that would rally the scattered resources of the country, guide them into proper channels and bring about a proper co-ordination between this basic industry on one hand and all the productive industries on the other, to the mutual benefit of both and to the general prosperity of the country.

* Based on the report on the "Development of Electrical Industry in India" submitted recently to the National Planning Committee, from the Department of Electrical Technology, Indian Institute of Science, Bangalore.

Experiments on the Cold Storage of Mangoes and Other Fruits and of Vegetables

ONE of the most important schemes, judged both by its applicability to the whole of India and by the promise of its commercial possibilities, relates to the Cold Storage experiments started by the Imperial Council of Agricultural Research in Kirkee near Poona. Begun in the year 1934 these experiments have now been in progress for about five years and the results obtained so far have been embodied in two separate publications of the Council, *viz.*, *Miscellaneous Bulletins* Nos. 21 and 23, on "Mangoes" and "on Fruits and Vegetables" respectively. The cold storage plant employed in these experiments consists of an ammonia compressor, with evaporating coils cooling down brine which circulates in the different chambers. Seven such chambers, all operated automatically with regard to the regulation of temperature and designed to work with seven different temperatures, which in these experiments were 30, 35, 40, 45, 52, 60 and 68 degrees Fahrenheit, comprise the arrangement. Some 28 different varieties of mangoes from the provinces of Madras, Bihar, the U.P. and Bombay were subjected to the trials. The results of these trials have established that fresh fruit, *i.e.*, "green in colour and mature" can keep well for about seven weeks when held at 45° F. and that that is about the best temperature, all factors considered, that the Alphonso variety was found the best "keeper", that an interval of two days after picking from the trees makes no difference from freshly picked fruit in regard to keeping up to seven weeks, and that the cold stored fruit kept well and ripened normally when taken out and kept at room temperature, *i.e.*, 80–96° up to a week after such removal. Among the Madras varieties Peter appeared to be the best, its storage life being, however only four weeks. The Bihar and U.P. varieties were all poor as regards suitability for storage; it must be remembered that these fruits from long distances had suffered from the conditions of railway transport in the heat of the summer and under better conditions may perhaps behave differently. The wrapping of the fruit before being put in cold storage was found decidedly undesirable, far from its being of any advantage as might be supposed. Likewise fruit kept best when packing materials like rice straw, wood-wool, saw-dust, mango leaves, etc., were not used; only the bare minimum of such material that may be required to keep the fruits in position in the crates is recommended.

Among other fruits, the work on oranges is certainly the most important. Santra oranges from Nagpur and Malta oranges from the Punjab were the two kinds tried, and the latter was found superior to the former in respect of keeping. The fruits have to be ripe and yellow in colour, and at this stage the Maltas keep for four months and the Nagpurs for three months, held at 40° F. As with mangoes pre-storage treatment such as wrapping in paper or washing with antiseptics proved of no advantage. Other fruits tried were bananas, chikoo, litchi, apples, lemons and among vegetables potatoes, cabbage, cauliflower, French beans, peas, carrots and onions. All have lent themselves to keeping under cold storage for varying periods with the exception of the cauliflower which did not keep even for a week. Potatoes behave remarkably well; at 35° F. seed potatoes remained in dormant condition for about a whole year, with their germinating power unimpaired even after ten months of such storage.

Elsewhere we read that practical action with regard to arrangements for exporting Indian fruits to overseas markets and for providing cold storage facilities in inland railway transport awaits the results of these experiments. It may now be hoped that such action may soon be taken by the Central Government. The results deserve also to be made more widely known among people connected with the trade in mangoes and other fruits so that private enterprise may take advantage of the results in order to widen the markets for these fruits and vegetables and to lengthen the season for these fruits, so to speak, by avoiding gluts and by assuring an even supply. A. K. Y.

Museums Association for India

THE question of the establishment of a **Museums Association** for India was considered by the Museums Conference held at Delhi in 1937 and the Conference resolved that a Central Committee should, as a preliminary, be appointed to consider ways and means of bringing the proposed Association into being. This Central Committee was to consist of seven people, among them being the Director of the Archæological Survey of India, the Director of the Zoological Survey of India and the Director of the Art Museum at Baroda with Mr. S. H. Prater, Curator, Bombay Natural History Society, as Honorary Secretary. Besides the formation of a Museums Association the object of this Central Committee would be the improvement of the standard of Museums and Museum work in this country and to provide a permanent focus of co-ordination and co-operation which is essential to the purpose. The total absence of such co-ordination in India or the means to effect it is deplored by the Markhan Report. Conferences of Museum officials, held under the ægis of the Government of India in the past, have urged the importance and necessity for a permanent Standing Committee on Museums in India. The recent Conference of Curators in Delhi, during the very

brief period it was in session, was unable to give sufficient time and consideration to the various problems affecting Museums in India. It was the unanimous opinion of those present that various questions relative to the training and qualifications of Curators, the co-operation necessary to this end, the improvement and extension of the services of Museums to the nation, the elimination of unnecessary overlapping and duplication of effort, the solution of many problems with which Museums in this country are confronted and the removal of disabilities under which they suffer were all matters which could be considered with greater advantage by a permanent body. An organisation such as is contemplated would prove of great encouragement and helpful assistance particularly to smaller museums which are now struggling under difficulties with little expert knowledge to guide them. It will also provide a body to which those contemplating the establishment of Museums or Art Galleries can look to for guidance and it will be able to express authoritative opinion on matters relating to such institutions.

It is clear that without a permanent organisation for focussing and continuing effort, the work of periodic conferences of Curators would be largely ephemeral. It is unnecessary further to emphasise the need of such an organisation or to indicate the contribution it could make to the progress of Museums in this country. The cost of maintaining a Standing Committee would in the initial stages entail the salary of a clerk, the cost of postage and stationery; there would also be the question of travelling and halting allowances to the members of the Committee for attending meetings arranged periodically at various centres in India.

Resolution 4 of the Conference recommended that the cost of maintaining the Standing Committee should be borne by the Government of India. It is understood that the Government of India have approached the various Provincial Governments and States with a view to ascertaining how far they would be prepared to contribute towards the maintenance of a permanent Standing Committee. The establishment of the Central Standing Committee should be the preliminary to the forming of a Museums Association and the question as to whether this Committee will function is dependent on the various Governments and States concerned providing for its upkeep.

CENTENARIES

By S. R. Ranganathan, M.A., L.T., F.L.A.
(University Librarian, Madras)

O'Callaghan, Francis Langford (1839–1909)

FRANCIS LANGFORD O'CALLAGHAN, an Irish Indian Engineer, was born at Cork, July 22, 1839. Having been educated at Queen's College, Cork, he received his training in engineering between 1859 and 1862, when he was employed in railway construction in Ireland and South Wales. In 1862 he entered the Public Works Department of India by competitive examination. He steadily went up the cadre until he reached the top-position of Secretary to the Public Works Department, from which post he retired in 1894.

His Chief Constructions

He built the bridge across the Indus at Attock. This earned for him a C.I.E. He designed and partly constructed the railway through the Khoja Pass to the Afghanistan frontier. He also built the railway line to Quetta. This earned him a C.S.I.

On his retirement, the Colonial Office appointed him managing member of the Uganda Railway Commission. His services in connection with this undertaking were rewarded in 1902 with the K.C.M.G.

O'Callaghan died suddenly, November 14, 1909.

Balbach, Edward (1839–1910)

EDWARD BALBACH, an American metallurgist, was born in Karlsruhe, Baden, Germany, July 4, 1839. His father, who was engaged in the smelting and refining of metals, migrated to America with his son and opened at Newark, the centre of extensive jewellery manufacture, a business for the treatment of jewellers' sweepings, which formerly had been sent to Europe. This business steadily grew and was extended to the general metallurgy of silver-lead ores. Young Balbach began to help in the growing business in his fourteenth year. He was admitted a partner in 1864.

Balbach Process

From 1859, large consignments of silver-lead ore came for smelting and refinement. The methods for treating this material were both expensive and inadequate. But in 1864, Balbach introduced a great improvement in the desilverizing process, which revolutionised the methods. The process came to be known as the Balbach Process. Balbach also made many improvements, as for instance, retorting furnaces, tilting furnaces and the utilisation of water-jackets.

Electrolysis of Copper

Another notable achievement of Balbach was in 1881 when he built the first commercial plant in America for the refining of copper by electrolysis, laying the foundation for the position America reached in the business in later years.

His Qualities

His inventive genius was coupled with a practical bent of mind. He studied and learned the business from the botton up, with a tireless energy and zeal. His presence at his post both early and late set a constant and good example to the younger generation.

Balbach died of pneumonia December 30, 1910.

SCIENCE NOTES AND NEWS

Daguerre's Discovery.—Photography has become so common to-day that it is difficult to realise the excitement its discovery caused. It was 100 years ago on January 7, 1839, that M. Arago announced to a meeting of the *French Academy of Sciences* (Applied Physics Section), the epoch-making discovery of M. Daguerre. The capturing or fixation of the vivid images made by the camera obscura or dark room was a goal long sought. Previous attempts at using layers of photo-sensitive salts like AgCl had proved quite unsatisfactory and the invention of Daguerre was hailed with enthusiasm by a Committee of the Academy consisting of Hunmbolt, Biot and Arago. Three of Daguerre's best results were exhibited in the Great Gallery adjoining the Louvre and the Tuileries, and a request was sent to the Council of Ministers for an adequate recompense for this discovery which was a product of several years' hard work.

It is interesting to note that at this very first announcement of the discovery, the value of photography as a precious tool for new investigations in physics and astronomy was fully realised and a picture of the moon was taken by M. Daguerre himself at the request of the Academy.

* * *

A relatively new technique in electro-analytical chemistry, is the **Polarographic Method** invented about 16 years ago by Heyrovsky. It is based on the principle that when a continuously increasing potential difference is applied to a solution containing electro-reducible or oxidisable substances, the current passing through the solution shows stepwise increases at finite voltages corresponding to the "decomposition voltages" of the substances present. Under favourable conditions as with a cathode of dropping mercury, steady and reproducible, current-voltage curves can be obtained. The voltage at which any step occurs, or better still the "half-wave potential", i.e., the potential of the dropping electrode against an external reference electrode, is characteristic of some definite electro-reducible substance present in solution. Also, the value of the limiting current of each step or wave, is determined by the concentration of the substance causing it. Thus it is often possible to obtain a simultaneous qualitative and quantitative analysis for several constituents in an unknown solution from a single current-voltage curve. The number of substances subject to polarographic determination is potentially very great, including all the common electro-reducible inorganic ions and a large variety of organic substances. The method is specially suitable for small concentrations (10^{-5} to 10^{-2} molar) and can be carried out with a volume of solution as small as 0·1 c.c. or even less. The principles and theories involved in this highly promising and widely applicable analytical method have been recently reviewed by I. M. Kolthoff and J. J. Lingane in the February number of the *Chemical Reviews* (1939, 24, 1–91).

M. A. G. RAU.

* * *

Artificial Ripening of Fruits with Acetylene.—According to a press note from the International Institute of Agriculture, Rome, the results obtained during the past ten years at different experiment stations, in the United States, the Union of South Africa, Australia, Italy and France, in the use of acetylene for artificial ripening of bananas, tomatoes, citrus fruit, pineapples, plums, etc., justify the use of this process in commercial practice. In this connection, the conclusion of the Marrakesh Experiment Station, Morocco, may be quoted "artificial colouring by means of acetylene gas is a commercial operation that makes it possible to market fruit about ten days in advance of the normal marketable date without in any way affecting its intrinsic varietal qualities". An article published in the *Monthly Bulletin of Agricultural Science & Practice* (1939, 30, 1), deals with the artificial ripening of fruits by acetylene. It is shown that "the action of acetylene is comparable with that of ethylene since its only effect is to hasten natural ripening by stimulating the action of the enzymes that normally exist in the plant".

* * *

In a recent number of the *Proceedings of the Royal Irish Academy* (Vol. XLV, Section B, No. 11), Dr. J. Kaye Charlesworth has published an interesting paper on "Some observations on the glaciation of north-east Ireland". The previous work of Dr. Dwerryhouse in 1923 on the glacial geology of this area had already established two important conclusions: (1) that of an early Scottish glaciation of north-east Ireland, the limits of which lay west of the present area; and (2) that of a subsequent union of Scottish and Irish ice-sheets which formed confocal hyperbolæ, more or less symmetrically disposed about Lough Neagh. The present study by Dr. Charlesworth deals with the way in which the ice disappeared from the Lough Neagh area and the valleys of the Bann, Main and Lagan, involving a detailed mapping of the fluvio-glacial sands and gravels which Dwerryhouse had largely neglected. As a result of this work, the author has shown many other things, that the drumlins of north-east Ireland "belong to the last main glaciation when the Scottish ice and Irish ice were confluent over the Loch Neagh basin. Their lack of parallelism with the successive ice-fronts established by other means and the dependence of their alignment upon major physical features seem to prove this age and relationship". The investigations described in this paper represent a further development of those of Dwerryhouse.

* * *

Observations on Crystalline Silica in Certain Devitrified Glasses.—Tool and Insley (*J. Research, National Bureau of Standards*, 1938, 21, 743) present the results of a series of tests

made with a view to observe in devitrifying glass the transformations: noncrystalline silica-crystobalite-trydimite-quartz, in the temperature range 625° to 950° C. A study of the devitrification products was made by obtaining the heating and cooling curves during the process and also by microscopic and X-ray observations.

Data are given for (*a*) inversion points of crystobalite on heating and on cooling; (*b*) the upper and lower inversion points of trydimite on heating and on cooling; and (*c*) inversion point of quartz.

The authors discuss the significance from several points of view the observed features of the inversion effects in the upper trydimite range.

K. R. K.

* * *

Concrete as X-Ray Protective Material.—With a view to avoid the high cost and the problem of supporting the large mass of lead required for X-ray protection at potentials above 200 kv., George Singer, Lauriston S. Taylor and Arvid L. Charlton (*J. Research, National Bureau of Standards*, 1938, 21, 783) have investigated the lead equivalents of various types of concrete in the range 200–400 kv. The protection coefficient of concrete was found to increase rapidly with increasing excitation potential, *e.g.*, a barrier of about 30 cm. was adequate at 400 kv. while at 200 kv. the thickness required was 22 cm.

K. R. K.

* * *

Physiological Palmistry.—Many believed and still believe that the dispositions and even the fates of persons can be read by a study of the individually different formations of the lines of the hand. The prosaic physiologist like Prof. Dr. Armin Tschermak-Seysenagg of the German University at Prague, sees in it (*Forsch. u. Fortsch.*, 1939, 15, 214) only a tube-like structure of our skins, which resembles the plate-like structure of the epidermal armour of certain animals. The skin folds itself according to and corresponding to these lines, during certain movements and positions. The most important hand lines are as follows: first the thumb bending line, secondly the opposition line (the life line of the Chiromancers)—corresponding to the placing of the thumb exactly opposite to the other four fingers held in the stretched out position, thirdly a pincer or principal folding line of the palm corresponding to the folding through complete pincer closure between the thumb and the four finger group, fourthly a pointer line corresponding to the small pincer closure between the thumb and three fingers towards the ulna, the pointer finger being kept stretched, fifthly an approachment line (the fate line of the Chiromancers) of the two pairs of the four finger group under stretching of the middle finger, sixthly a folding line of the fourth and little fingers—used when the fourth and fifth fingers are bent keeping the second and third fingers stretched, which is the usual position when administering an oath or a blessing. A double furrow permits the bending of the palm towards the lower arm, corresponding to the first and the second steps in the folding of the hand. This kind of formation of the skin exists already in the case of newly born children. Just the same way as the furrows on a finger can be recorded as in Dactylcscopy so also can these lines be recorded like a document by smearing the palm with soot, printer's ink, and oil colours and then pressing on a paper. In this way was proved a remarkable identity in the formations of the lines of the hand in the case of a pair of single cell twins. Much more interesting and instructive are the so-called Rontgenchirogrammes which are obtained by rubbing on to the palm Bismuth pulp, or Bismuth ointment, and then wiping it off and afterwards obtaining a Rontgen photograph. Thereby it appears that the relationship of the position of the lines of the hand to that of the bones and joints of the hand, can be determined. It is to be expected that out of this will arise a perfectioning of the system of registering and identification of individual persons, which is so important from the criminological point of view. N. G. C.

* * *

Hand-made Paper.—The Industrial Section of the Indian Museum (Botanical Survey of India) has collected valuable information from various parts of India on the methods of manufacturing hand-made paper. A sample of paper obtained from Nepal, which is said to last for 1,000 years or more, has been exhibited at the Indian Museum, Calcutta, where charts have been put up showing in a simple manner the processes through which hand-made paper has to pass before it emerges out as finished product.

The fibre of *Sunn Hemp* (*Crotalaria juncea*) is the principal raw material for making paper in Manipur State. In the Shan States, the bark of *Thale* (*Broussonetia papyrifera*) is employed. Rags, old clothes, cotton waste, etc., are generally employed for making good paper in various parts of India.

Other raw materials used for paper-making are, straw, bamboo, the bark of *Aquilaria agallocha* and jute. The Industrial Research Laboratory of the Industries Department, Government of Bengal, has been investigating the possibilities of using dried water-hyacinth stems and stems of jute plant stripped of the fibre, for making paper. The Benares Hindu University has taken up the production of hand-made paper from easily available raw materials. Experiments have also been undertaken at the Forest Research Institute, Dehra Dun, to improve indigenous methods with a view to developing hand paper-making into a cottage industry.

* * *

Vegetable Rennet.—An extract from the berry of *Withania coagulanas* obtained from the N.W. Frontier Provinces, can be employed as a substitute for rennet in cheese making. It is understood that cheddar cheese and soft cheese of good quality have been prepared at the Imperial Dairy Institute, Bangalore, by employing vegetable rennet.

* * *

Iron and Coal Deposits.—New deposits of coal, iron and gold have been discovered in India according to the *General Report* of the Geological Survey of India for 1938.

In one workable seam alone in the Langrin area in Assam a total reserve of 80,000,000 tons of coal is indicated and there are 610,000,000 tons of first class iron ores in Bastar State, Eastern States Agency.

The coal area in Assam lies in the south-western corner of the Khasi Hills between the Um Mawblei and the border of the Garo Hills, into which also the coal-bearing strata extend. It is divided structurally into two unequal parts by a strong cross fault.

By far the most important areas for development are those of the Langrin plateau east of the fault. Coal seams outcrop in almost every deep ravine that discharges into the Sylhet plains between Bagali Bazar and the limestone outcrops beyond Barsaura. Most of these seams lie in deep gorges on the plateau and contain pebbles of coal from seams exposed in the cliffs on each side.

The mapping of the iron-ore deposits of the Bailadila range, Bastar State, has been completed. Ore deposits, large and rich enough to be worked economically, occur in numerous places along the two high ridges which flank the range and on the watershed of the Malengar at the southern end of the range. The largest deposits are two on the watershed of the Malengar and one about two and a half miles north of Loa. In these three deposits there are at least 400 million tons of ore.

* * *

Indian Short-wave Stations.—The data collected by the Research Department of the All-India Radio during the past 18 months have yielded valuable information on the relative advantages of the short- over medium-waves and the choice of the day (31 metre) and night (60 metre) wave bands under the Indian conditions.

In the tropics, atmospherics also called static, mar reception during the monsoon weather. Measurements indicate that their magnitude is about fifty times greater in India than either in Europe or America; it is about fifty times stronger on medium- than on short-waves.

The 31-metre band is interference-free during the day. The chief considerations in the choice of the 60-metre band are: (1) freedom from interference due to other stations (unlike the overcrowded 49-metre band with 197 stations!); (2) good reception primarily in India; and (3) minimising the 'skip distance' trouble.

With these bands, therefore, Indian listeners can expect reasonably good reception in all seasons. It may be mentioned that the All-India Radio received proofs of satisfactory reception of Indian stations even from Europe and America.

* * *

Mineral Springs in India.—Occurrence of two sulphurous springs in Riasi District, Kashmir, is reported by the Geological Survey of India. The one, which is situated about a quarter of a mile above Khar along the Tawi River, discharges hot water only during winter. It precipitates a good deal of milk of sulphur. The other is the well-known thermal spring at Tattapani. Its water is apparently possessed of certain therapeutic properties for curing skin diseases and gouty affections. The water gives a strong sulphurous odour and maintains a constant high temperature of 70°–80° C.

Several years ago the Geological Survey of India compiled a catalogue of the hot springs in this country, but this information is in need of additions both with regard to the radio-active and mineral character of the waters from a geological aspect and the medicinal properties of the water from a medical point of view.

It is understood that an exhaustive examination of the mineral springs of India is under consideration and it is hoped that the Geological Survey of India will shortly undertake the work. The determination of the physical and chemical constitution of the mineral waters must be supplemented by an investigation of the cures which are said to have been effected by the various waters and for this purpose medical collaboration appears essential.

* * *

Laminated Wood.—It is curious that while much attention has been paid in this country to the possibility of Plywood manufacture, laminated wood construction (more commonly called "Laminboards") is still in the nature of novelty. Laminboard technique has made great advances in Europe and America and large panels right up to 30 to 40 mm. thick are available at competitive prices. The many advantages which such construction offers are of even more value in a country like India with its extreme climatic conditions.

In a recent pamphlet by Mr. W. Nagle, Officer-in-charge, Wood Working Section, Forest Research Institute, Dehra Dun, the basic information about laminated wood is presented in seven compact and readable sections entitled Introduction, The History of Laminboards, Methods of Manufacture of Laminboards, Uses of Laminboards, Cost of Laminboard Making Plant, Details of a small Laminboard Plant and Some Machine Makers. The information provided in these paragraphs is just enough and of the kind to enable the serious student or manufacturer to ask further questions regarding details. Such enquiries, Captain H. Trotter, Utilisation Officer, Forest Research Institute, Dehra Dun, assures the reader in a "Foreword", will be gladly answered.

The publication is illustrated by a number of photographs. The frontispiece illustrating the Board Room at the Forest Research Institute, Dehra Dun, does scant justice to the beauty of the original. It is true that no "black and white" picture can adequately bring out the quiet charm of wood panels but the reviewer cannot help feeling that a little more expense for better "get-up" of the illustrations would be justifiable in such avowedly propagandist publications.

EMMENNAR.

* * *

India Meteorological Department.—The Administration Report (1937–38) of the Meteorological Department of the Government of India, that has been recently published, gives a brief account of the routine work of the Department as well as of the developments—some of them of far-reaching importance—that have been carried out during the year. The Report contains matter of considerable public interest, and will enable the reader to form an estimate

of the services rendered by the Department in the various activities concerning the affairs of the country. The first section of the report opens with a tribute to the memory of Mr. J. H. Field, a former Director-General of Observatories, who, it will be remembered, was responsible for a large amount of pioneer work in connection with the organisation required for the study of upper air in India. In the same section are summarised the outstanding features in the developments effected during the year. Mention is made of the preparation of the additional afternoon weather chart daily from 1st April 1937. Two forecasts are thus issued every day from Poona and a synoptic chart from the afternoon observations is also printed in the Daily Weather Report. Commencing from 1st August 1937, broadcasts of regional weather data have been made twice daily from the short-wave æronautical wireless stations at Karachi and Calcutta. A short-wave station is under construction at Poona by the Posts and Telegraphs Department which, when completed, will enable the Headquarters Office to issue collective and regional synoptic data. Several improvements have been brought into effect, in the meteorological service to aviation interests, since the introduction of the Empire Air Mail scheme and the development of internal air transport.

In Section II of the Report are given in some detail the services of the Department in connection with storm warnings to shipping in the Indian waters; and in Section III, we have an account of the arrangements made for supplying weather information and forecasts to aviators on the various air routes in the country. Section V contains a brief description of the normal duties of the different sections of the Headquarters Office as well as of the meteorological offices and observatories maintained by the Department. A concise account is given of the special researches carried on at these centres and is sure to be of interest not only to meteorologists but also to workers in allied branches of science. Of particular importance to an agricultural country like India are the investigations made in the Agricultural Meteorology Section at Poona where studies have been continued on a number of problems connected with climate and crops.

The study of the earthquakes that recently occurred in India and its neighbourhood, and the determination of focal depths in some cases, have received attention at the Colaba Observatory, which acts as a central station for collecting and editing the data obtained from the records of all the seismographs operating in India and Ceylon. A quarterly Bulletin containing the readings of the principal phases of seismograms is being published from the beginning of 1938.

Much of the routine work of the Kodaikanal Observatory is planned in co-operation with the International Astronomical Union. Among the chief features of the year, mention is made of the discussion of the observations secured at the Observatory Eclipse Expedition to Japan in 1936, the publication of a note on the presence of oxygen in solar prominences and the construction of a 13 ft. spectrograph of the Littrow type for the systematic study of the contours of selected lines in different parts of the sun's disc and in sunspots.

A list of publications issued during the year is contained in Appendix B, which gives an idea of the extent of the research activities of the Department. T. P. B.

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The Report for 1938 of the **Solar Physics Observatory**, Kodaikanal, which specialises in the study of the Sun and makes daily visual and photographic observations of its changing features has just been issued.

There was a slight decrease in almost all forms of solar activity during the year except in prominence areas which showed an increase over the previous year's. Not on one day was the Sun's disc free from spots. The mean daily number of sunspots fell by 16 per cent. and the number of new groups by 13 per cent. An increase of 12 per cent. was observed in the mean daily areas of calcium prominences, but the mean daily numbers of prominences decreased by 6 per cent.

Photographs of the Sun on a scale of eight inches to the Sun's diameter were taken on 328 days using a six-inch achromatic object glass and a green colour filter. A statistical study of prominence areas was made to determine the possible influence of the earth on solar prominences. Photometric work on the intensities and contours of selected Fraunhofer lines made further progress.

A line-shifter was designed and mounted on the H_α spectroheliograph and a twelve-inch siderostat was built up and mounted. The spectrum of Bromine was photographed and precise measures of intensity were made by photographic photometry for a few lines.

Data of cosmic radiation obtained from measurements at Agra and Kodaikanal were analysed and its diurnal variation with mean and sidereal times worked out.

Weather conditions were slightly less favourable for solar observation. The Observatory carried out the programme of the International Astronomical Union.

The Milne-Shaw Seismograph recorded 255 earthquakes during the year.

* * *

Report on Child Welfare.—The League of Nations has just published the *Annual Report* on Child Welfare prepared by the Child Welfare Information Centre, containing a survey of the principal legislative and administrative measures adopted or examined in 1937 in some thirty countries, with a view to improving and extending the protection afforded to the child, its mother and the family (*Document Ser. L.o.N.P.*, 1939, 4, 5, pp. 201. Price 4*sh.*).

A Press Communique issued by the Information Section of the League, draws attention to the important features of the report, which gives *inter alia* a general account of the measures adopted in China and a summary account of the work being done in the province of Kwang-si, the most advanced province as regards the organisation of social services. Some short historical notes are included in the report, which show the importance of the social evolution at present transforming China.

The information on the United States and the United Kingdom is very complete, and shows the importance attached by these great countries to the improvement of the health of the mother and child and to physical education.

The report contains a concise summary of measures concerning the child contained in the Swiss Penal Code of December 31st, 1937, as well as interesting information on Turkish child welfare legislation and its application.

The report should prove useful to all who are interested in the organisation and social development of the various countries or who are investigating the methods adopted to protect the mother and child with a view to determining a country's level of civilisation.

* * *

Atmospheric Pollution.—The purity of the atmosphere is a matter of concern to everyone, especially those living in industrial districts and crowded city areas. The available facts on the extent, character and variation of atmospheric pollution are contained in the Annual Reports on observations made by local authorities and other bodies co-operating with the Department of Scientific and Industrial Research in the study of the subject. The 24th Report, just issued (H.M. Stationery Office; Price 2*sh.* net.; General Deposit Tables 4*sh.* 6*d.* net.), records and discusses the results obtained in the year ending 31st March 1938. A special illustrated section of the Report is devoted to a brief explanation, in simple language, of the part played by atmospheric pollution and other factors, in causing fogs.

The results of measurements made with the deposit gauge are, as usual, analysed and discussed in the Report, but the detailed figures of deposited impurity, contained in the General Deposit Tables, which were formerly embodied in the Report, are now issued as a separate publication.

* * *

The Seventieth Annual Report of the **American Museum of Natural History**, recently received, records a general expansion in the activities of the museum; this is remarkable considering the fact that the management was faced with a fall in the income and many departments were understaffed. New exhibits were added and the scientific and educational work of the Museum were extended. At the request of the authorities of the New York World Fair, the Museum has planned a temporary exhibition of primitive art, utilising original pieces from the extensive collection from the Americas, Africa and Polynesia. In the Hayden Planetarium, two spectacles designed for the layman's appreciation of atsronomy are planned. One reveals the circumstances by means of which, life on earth or the earth itself might come to an end; the other carries the visitor on a trip to the moon and gives him a realistic picture of the surface of our nearest cosmic neighbour.

The research activities of the Museum cover a very wide field, and the results of the investigations have been recorded in several reports, monographs and journals; mention may be made of the work on the social behaviour of the vertebrates, evolution of the brain in fossil and recent vertebrates, dentition and jaws of the fossil South African man-apes. The Asiatic Exploration and research was continued and the results obtained by Dr. Glover M. Allen, on the mammals of China and Mongolia were published as Part 1 of Volume 9 of the series in the *Natural History of Central Asia*. Several expeditions were undertaken in North America, Central America, South America, Asia, Africa, South Seas and Pacific Islands, for acquiring specimens and for study. A study of the report cannot fail to impress the reader with the enormous influence which the Museum exercises in popularising scientific knowledge.

* * *

Spectrochimica Acta.—We have received the first number of the new journal, published by the well-known firm of Julius Springer, with the co-operation of an International Board of Chemists. Chemical analysis, both qualitative and quantitative, by the methods of emission spectra are being increasingly adopted by many firms and institutions. Improved technics in exciting the spectral lines, and their estimations both by visual and photographic methods, have brought out the general advantages of rapidity and convenience in these methods. In special cases as in 'trace' analysis, or in the estimation of rare-earth impurities, spectro-chemical methods possess distinct advantages. Their applicability to wider regions as in the identification of different alloys, precipitates, concentrates, frits, enamels, etc., has called forth special researches, and a forum for the publication of these researches is now provided by the new journal. The Board of Editors are R. Brackpot (Louvain), A. Gatterer (Castel Gandolfo), W. Gerlach (München), G. Scheibe (München) and F. Twyman (London). The journal will be published at varying intervals. The first number (24 May 1939; Price 8·60 RM.) starts off with a contribution from Prof. H. Kayser on "Beobachtungen über Abfunkvorgänge bei der Spektral analyse von Aluminiumlegierungen". There are four other articles on "The Quantitative Spectrographic Analysis of Solder, Spelter Magnesium and Aluminium Alloys" (McClelland and Whalley), "Die quantitative Bestimmung kleinster Mengen von Europium in Samarium" (Gatterer and Junkes), "Über eine neue Anwendung der Emissionsspektroscopie zur lokalen Mikro-Analyse" (Scheibe and Martin), and "Die physikalischen Erscheinungen der Bogenentladung in ihrer Bedeutung für die spektralanalytischen Untersuchungs methoden" (Rollwagen). Finally there is a section, which will be a feature in all the numbers, on book reviews and abstracts of articles pertaining to the subject proper of the journal.

* * *

Humidification of Freezers.—The primary cause of deterioration in frozen products under the conditions prevailing in the freezers, now in vogue, is surface drying or as it is more generally known, freezer burn. This condition can be reduced or prevented by packing the product in a more or less moisture-proof manner. The refrigeration engineer has contributed very little to minimise this form of

deterioration beyond the possible use of very low storage temperatures.

Freezer burns can also be prevented by humidifying the atmosphere of the freezer. The practicability of the method was suggested by Dr. W. H. Cook of the National Research Council, Ottawa, in a paper presented at the Food Technology Conference recently held at the Massachusetts Institute of Technology. The conditions necessary for ensuring continuous evaporation from the product have been worked out and a humidifying apparatus has been designed which will serve to maintain humidities of 95% with a heat input equivalent to a 10–15% increase in the refrigerating load.

* * *

A delegation of agricultural experts with Mr. A. Mustafa, Agricultural Officer, Baluchistan, as leader and Dr. B. B. Mundkur, Assistant Mycologist, and Dr. Taskir Ahmad, Assistant Entomologist, of the **Imperial Institute of Agricultural Research**, New Delhi, as members, has left for Afghanistan, at the invitation of the Afghan Government with a view (1) to give suitable assistance and advice as is possible, to the Afghan Government in regard to crop production; and (2) to collect such information regarding Afghan agriculture as may be of interest and value to India. The delegation will devote particular attention to the fruit cultivation with special reference to the prevalent pests. A sprayer and necessary materials for spraying have been taken in order to demonstrate the methods of dealing with insect pests. Necessary equipment for collecting insect fungus and plant specimens has also been provided. Fruit cultivation, the most important item in Afghanistan Agriculture, is extensively carried out in the irrigated valleys lying to the south of the country. The delegation will also interest itself in problems connected with locusts and locust attacks. The locust affected area lies in the north-east and north of Afghanistan, especially in the plain of Oxcus. It is expected that the delegation will complete its labours in about a month.

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Prof. F. C. Minett, D.Sc., M.R.C.V.S., Director of Research, Institute of Pathology, Royal Veterinary College, London, has been appointed Director, Imperial Veterinary Research Institute, Government of India. He is expected to take charge of his duties early in September.

* * *

University of Mysore.—1. The triennial elections to the Senate by and from the Academic Council and the Registered Graduates were held.

2. Refresher Courses for the High School teachers deputed by the Department of Public Instruction were held in the Maharaja's College, Mysore, in Arts subjects and the Central College, Bangalore, in Science subjects.

3. Arrangements were made for publishing the following Extension Hand-books in Kannada: (1) Our Villages. (2) Astronomy. (3) Diseases of Society. (4) Taxes. (5) Nine Gems.

4. The results of the University Examinations held in March 1939 were announced. They were as under;—

Sl. No.	Examination	Examined	Passed
1	Intermediate	1,204	554
2	B.A. (New)	158	85
3	B.A. (Old)	3	2
4	B.Sc.	193	116
5	B. A.(Hons.) Preliminary ..	41	31
6	B.Sc. (Hons.) Preliminary ..	32	27
7	B.A. (Hons.) Final	44	40
8	B Sc. (Hons.) Final ..	47	45
9	M.A. (Qualifying Test) ..	4	4
10	M.Sc. (Qualifying Test) ..	1	1
11	B.T.	54	37
12	First Examination in Engineering	73	58
13	Second Examination in Engineering	73	41
14	B.E.	47	34
15	Pre Medical	29	10
16	First M.B.B.S.	25	13
17	Second M.B.B.S.	29	19
18	Final M.B.B.S.—Part I ..	21	14
	Part II ..	28	14
	October 1938		
19	First L.M.P.	17	9
20	Second L.M.P.	25	17
21	Third L.M.P.	45	22
22	Final L.M.P.	46	26
	March 1939		
23	First L.M.P.	49	32
24	Second L.M.P.	34	17
25	Third L.M.P.	46	23
26	Final L.M.P.	44	23

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Royal Institute of Science.—The recent University results have been satisfactory. Out of the 80 candidates who appeared for the B.Sc. Principal subjects, 72 have passed giving a total percentage of 90.

Dr. R. C. Shah has been promoted to B.E.S. Class I, as Professor of Organic Chemistry.

Dr. Y. G. Naik, PH.D. (Bom.), of the Physics Department, has been promoted to the post of Lecturer in Physics at the Gujerat College, Armedabad.

Dr. (Miss) M. M. Paranjpe, PH.D. (Lond.), has been appointed as Assistant Lecturer in the Physics Department in place of Dr. Y. G. Naik.

Mr. D. R. Nadkarni, M.SC., has joined the Chemistry Department as Assistant Lecturer.

The teaching of Mathematics will now be carried out jointly with the Mathematics staff of the Elphinstone College.

* * *

Announcements

A New **International Address Book** of Plant Taxonomists, Geographers and Ecologists is being prepared by the Editor of *Chronica Botanica* and will be issued in the near future in the "New Series of Plant Science Books". The Address Book will not only give the names and addresses of the scientists included, but also

their scientific interests, together with a conspectus of current and planned research. This is the same kind of information as was being included in *Chronica Botanica*, when it was issued as a year-book (Vols. I–III, 1935–37). Information on new research projects, especially in taxonomy, geography and ecology, in *Chronica Botanica*, the International Plant Science News Magazine, will henceforward be restricted to major co-operative projects and the like. As it is no longer practicable, or impossible, to compile an address book for the whole of plant science, it is hoped that similar address books will be prepared for other branches of plant sciences, *e.g.*, general botany (morphology, physiology, genetics), plant pathology, agronomy, horticulture and forestry.

Dr. Verdoorn, Editor, *Chronica Botanica*, (P.O. Box 8, Leiden, Holland) will be glad to send relevant questionnaire cards to those interested, on request.

A New International Hormone Standard.—It is announced that the standard for the gonadotrophic hormone derived from the human urine of pregnancy, which was adopted last year by the League of Nations at its conference for the standardisation of hormones, is now ready for distribution.

It consists of a mixture of six samples of hormone, which have been given by various manufacturers, and is presented in the form of tablets containing each about 100 international units of activity.

The National Institute for Medical Research at Hampstead has already sent supplies of this new standard to the national centres which have been set up in numerous countries for distribution to the scientific and commercial laboratories.

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We acknowledge with thanks, receipt of the following:—

"Journal of Agricultural Research," Vol. 58, Nos. 8 and 9 and Index to Vol. 57.

"Agriculture and Live-Stock in India," Vol. 9, Pt. 3.

"Agricultural Gazette of New South Wales," Vol. 50, No. 6.

"Journal of the Royal Society of Arts," Vol. 87, Pts. 4509–17.

"The Philippine Agriculturist," Vol. 28, No. 1.

"Monthly Bulletin of Agricultural Science and Practice," Vol. 30, No. 5.

"L'Agricoltura Coloniale," Vol. 33, No. 5.

"Biochemical Journal," Vol. 33, No. 5.

"Berichte der Deutschen Chemischen Gesellschaft," Vol. 72, No. 6.

"Journal of the Institute of Brewing," Vol. 45, No. 6.

"The Journal of Chemical Physics," Vol. 7, No. 6.

"Journal of the Indian Chemical Society," Vol. 16, Nos. 4 and 5.

"Chemical Age," Vol. 40, Nos. 1039–42.

"Journal de Chimie Physique," Vol. 36, No. 3.

"Chemical Products," Vol. 2, No. 2.

"Experiment Station Record," Vol. 80, No. 5.

"Indian Forester," Vol. 55, No. 7.

"Indian Forest Records," Vol. 3, No. 6.

"Forschungen und Fortschritte," Vol. 15, Nos. 16–18.

"Transactions of the Faraday Society," Vol. 35, No. 218.

"Review of Applied Mycology," Vol. 18, Nos. 4 and 5.

"The Bulletin of the American Meteorological Society," Vol. 20, No. 4.

"Nature," Vol. 143, Nos. 3625–33.

"American Museum of Natural History," Vol. 43, No. 5 and Vol. 44, No. 1.

"Journal of Nutrition," Vol. 17, Nos. 5 and 17.

"Journal of the Bombay Natural History," Vol. 40, Nos. 3 and 4.

"Indian Journal of Physics," Vol. 13, Pts. 1 and 2.

"Canadian Journal of Research," Vol. 17, Nos. 3 and 4.

"Research and Progress," Vol. 5, No. 4.

"Sky," Vol. 3, Nos. 5, 7 and 8.

"Science Forum," Vol. 4, No. 1.

"Science Reports of the Tohoku Imperial University, Japan," Vol. 13, Nos. 1–4.

"Indian Trade Journal," Vol. 132, Nos. 1715–16; and Vol. 133, Nos. 1717–24.

"Indian Central Jute Committee Bulletin," Vol. 2, No. 3.

"Comptes Rendus (Docklady)," Vol. 22, Nos. 5 and 6.

"Transactions of the Mining, Geological and Metallurgical Institute of India," Vol. 35, Pt. 1.

"Calcutta Medical Journal," Vol. 35, No. 6.

"Indian Medical Gazette," Vol. 74, No. 5.

"Occasional Notes (Royal Astronomical Society)," No. 4.

"Proceedings of Royal Netherlands Academy, Amsterdam," Vol. 42, No. 2.

"The Lingnan Science Journal," Vol. 18, No. 2.

"Science Progress," Vol. 33, No. 132.

"Indian Journal of Veterinary Science and Animal Husbandry," Vol. 9, No. 1.

"Proceedings of the Royal Society of Edinburgh," Vol. 58, Pt. 3, and Vol. 59, Pt. 1.

"Proceedings of the Royal Irish Academy, Dublin," Vol. 45, Pts. 7–12 (Section B).

Catalogues:

"Books on Insects and Spiders"; "Monthly List of Books on Natural History and Science—May 1939" (Wheldon & Wesley, Ltd., London).

ACADEMIES AND SOCIETIES

Indian Academy of Sciences

June 1939. SECTION A.—SIR C. V. RAMAN AND K. SUBBA RAMAIAH: *On the Wave-like Character of Periodic Precipitates.* Fourteen micro-photographs and enlargements of Liesegang precipitates are reproduced to show the characteristic superposition effects observable with waves. The examples illustrate the varying effects of the superposition of two wave-trains when their wave-length, direction, and amplitude are individually and collectively different. The so-called primary and secondary rings obtained with silver-chromate precipitates in gelatin are related to each other as a group is to the individual waves of which it is composed. K. SUBBA RAMAIAH: *Studies on Liesegang Rings.* It is shown that the fine secondary rings consist of silver chromate and are not due to the presence of impurities in the gelatin. Under suitable conditions, the precipitation of silver chloride and silver phosphate in gelatin is a periodic process, giving rise to a series of extremely fine rings. The rings exhibit interesting optical effects, such as diffraction spectra and different coloured haloes. S. MINAKSHI SUNDARAM: *On Non-Linear Partial Differential Equations of the Parabolic Type.* S. MINAKSHI SUNDARAM: *On Non-Linear Partial Differential Equations of the Hyperbolic Type.* M. W. CHIPLONKAR: *A Simple Cylindrical Lens Spectrograph for the Optical Determination of the Concentration of Ozone in the Atmospheric Layers near the Ground.* The slit and collimator are dispensed with, and the spherical camera lens is replaced by a cylindrical lens with its axis parallel to the refracting edge of the prism. R. K. MEHRA AND K. C. PANDYA: *The Condensation of Aldehydes—Part X. Of* p-*Tolylaldehydes with Amides; Part XI. Of* p-*Tolylaldehyde with Malonic Acid and Malonanilic Acid.* The amides give bisamide products, and malonanilic acid the cinnamaldehyde. K. C. PANDYA, T. S. SODHI AND D. S. MITTAL: *Condensation of Aldehydes with Malonic Acid—Part XII. The Influence of Groups and of Other Factors.* The hydroxy group generally diminishes the yield, which rises when the group is methylated. The nitro-group has no influence. R. NARAYANASWAMI: *Some Measurements of Chloride, Nitrate and Nitrite Present in the Water of the Monsoon Rains at Bombay.* S. RANGASWAMI AND T. R. SESHADRI: *The Question of the Fixation of the Aromatic Double Bonds in Hydroxy-Chromones and Coumarins. Formation of Azo-Dyes.* T. VENKATARAYUDU: *The 7–15 Problem.*

June 1939. SECTION B.—B. N. SINGH AND S. N. SINGH: *Photoperiodism and the Phasic Development of* Crotalaria juncea. B. N. SINGH, S. N. SINGH AND K. M. NAIR: *The Influence of Moisture Content and Nitrate Feeding on the Nitrogen Cycle in the Soil both under Aerobic and Anaerobic Conditions.* N. KESAVA PANIKKAR AND R. GOPALA AIYAR: *Observations on Breeding in Brackish-Water Animals of Madras.* SHYAM SUNDER LAL: *The Internal Ear of* Scoliodon sorrakowah (*Cuvier*).

Indian Chemical Society

April 1939.—R. N. MITTRA: *Formation of periodic precipitate in the absence of a foreign gel—Part II. Ferric hydroxide sol by different methods.* R. N. MITTRA: *Cupric hydroxide sol.* PRAFULLA KUMAR BOSE AND JOGENDRALAL BOSE: *Natural Flavones—Part III. On the constitution of tambulin.* K. P. BASU AND M. K. HALDAR: *Supplementary relations between the proteins of pulses and those of milk by the balance-sheet and growth methods.* P. C. MITTER AND LAKSHMI KANTA DE: *Studies in the γ-ketonic acids—Part II.* K. P. BASU AND M. K. HALDAR: *Biological value of the proteins of* Cicer arietinum (*Bengal gram*) *and* Cajanus indicus (*Arhar*) *by the balance-sheet and growth methods.* SISIR KUMAR GUHA: *On the preparation of 7-methyl-3-hydroxythionaphthene and its condensation with isatin.*

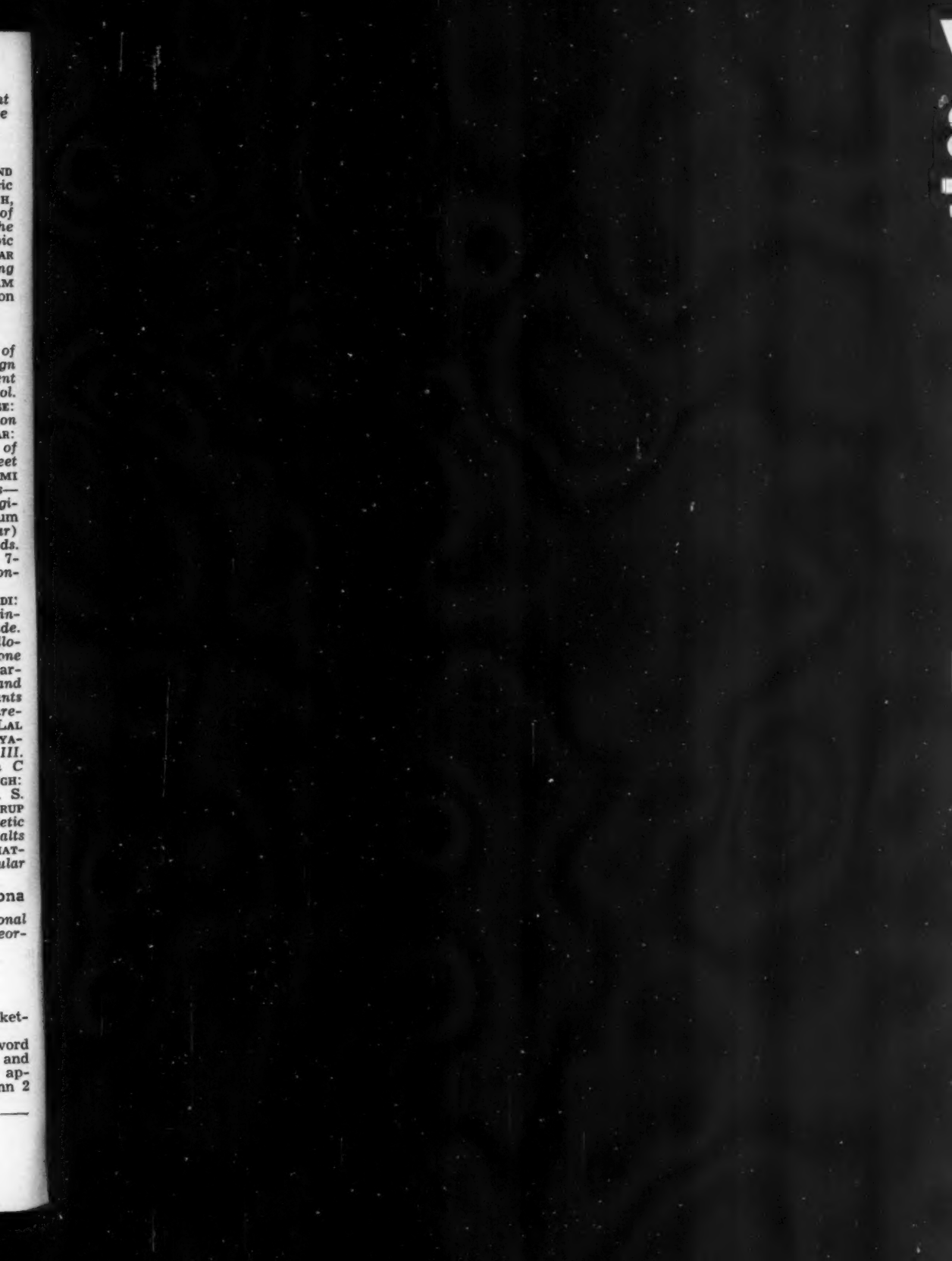
May 1939.—S. M. MEHTA AND M. B. KABADI: *The electrical conductivity of solutions containing zinc hydroxide and sodium hydroxide.* M. C. NATH AND P. L. MUKHERJEE: *Crystallographic investigation of artostenone, the stenone isolated from the Indian summer fruit,* Artocarpus integrifolia *by means of Goniometer and X-rays.* W. V. BHAGWAT: *Dissociation constants of some organic acids from solubility measurements.* PANCHANAN NEOGI AND KANAI LAL MONDAL: *Resonance reaction—Part II.* BAIDYANATH GHOSH: *Vitamin C and Toxins—Part III. The effect of diphtheria toxin on Vitamin C metabolism.* R. K. BAHL AND SURJIT SINGH: *Action of fuming nitric acid on iodine.* S. S. BHATNAGAR, A. N. KAPUR AND MAHENDRA SARUP BHATNAGAR: *Adsorptive properties of synthetic resins—Part II. Adsorption of potassium salts of various anions.* S. R. PALIT AND G. N. BHATTACHARYA: *A note on the basicity and molecular weight of shellac.*

Meteorological Office Colloquium, Poona

June 9, 1939.—V. SATAKOPAN: *Orthogonal polynomials* vs. *Harmonic functions in Meteorology and Geophysics.*

Errata

Vol. 8, No. 6, June 1939:

1. Note entitled "A Magnetic Study of the Oxides of Chromium and Manganese": *insert* the following between lines 22 and 23 in column 2 on page 253:— "at 65° after which there is a continuous fall".
2. The article entitled "Agricultural Marketing in Northern India": Page 277, column 1, *substitute* the word "linseed" in line 45 by "licensed" and *omit* the words "the failure of" appearing in lines 11 and 12 in column 2 of the same page.

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